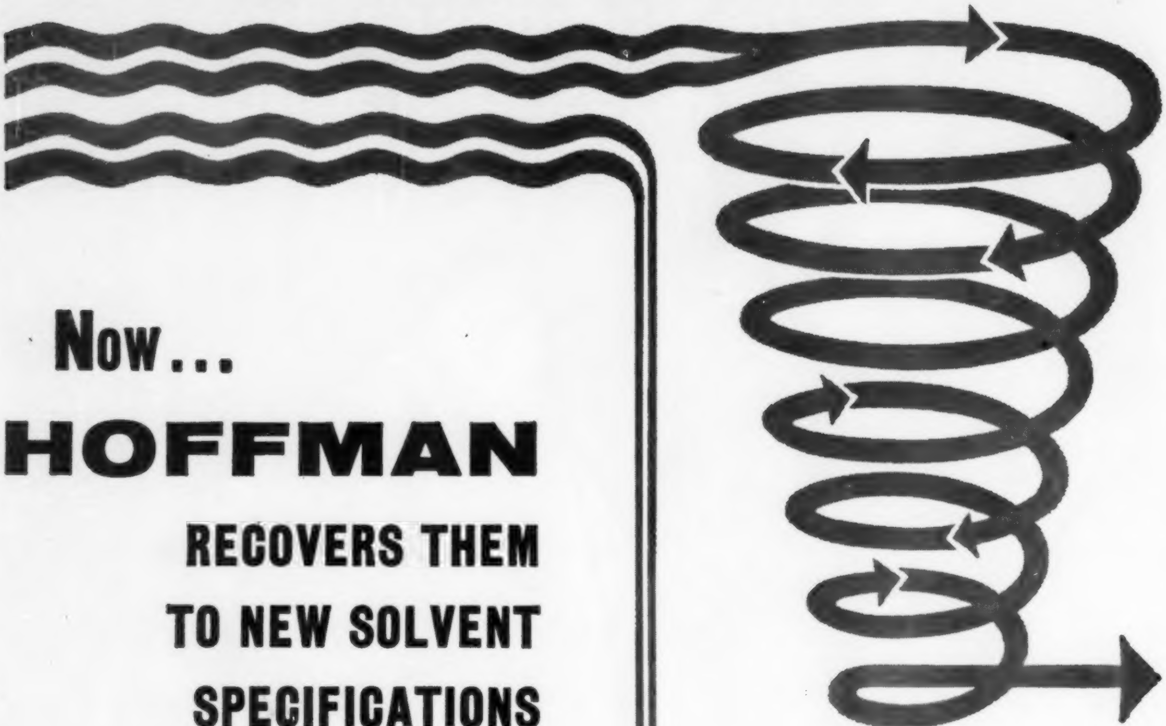
MECHANICAL ENGINEERING

November 1961

1961 ASME
Winter Annual Meeting
NEW YORK, N. Y.
Nov. 26-30

Plasma Engine for Space

OLD SOLVENTS NEEDN'T BE DRAINED AWAY...

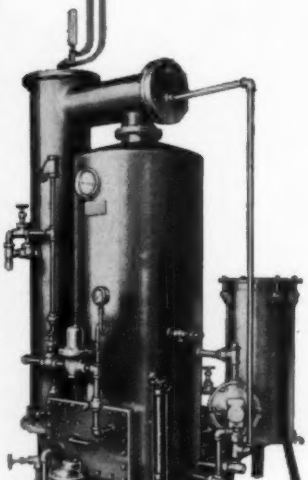


Now...

HOFFMAN

RECOVERS THEM TO NEW SOLVENT SPECIFICATIONS

at a cost of 1c per gallon



If the petroleum or synthetic solvents you use for washing and cleaning parts, tools, fixtures, dies, paint stripping and in production processes such as the manufacture of extruded plastic parts, rolling of aluminum foil, etc., are being dumped after use, money is going down the drain unnecessarily. Now it is possible to reclaim contaminated solvents — condition them to new specifications with the low-cost Hoffman industrial distillation system. Savings in solvent can be expected to pay for the Hoffman equipment in a short time.

To learn how a low-cost Hoffman vacuum distillation system can reclaim contaminated solvents in your plant, send for Bulletin FB-101 together with Case Study #12 on the plant that has regularly recovered 80,000 gallons of petroleum solvent a year at a cost of 1c per gallon.

FILTRATION DIVISION

HOFFMAN

INDUSTRIES, INC. A SUBSIDIARY OF HOFFMAN INTERNATIONAL

Dept. ME-1 • Thompson Road • Syracuse 6, New York • HOward 3-0251

Circle No. 167 on Readers' Service Card

MECHANICAL ENGINEERING

PUBLISHED BY
THE AMERICAN SOCIETY OF
MECHANICAL ENGINEERS

Contents

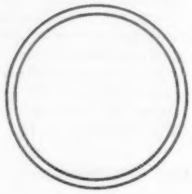
VOLUME 83 • NUMBER 11 • NOVEMBER, 1961

THE COVER

You don't really have to wear your space suit to look at it. This is a compact, lightweight propulsion system, developed at the Plasma Propulsion Laboratory of Republic Aviation Corporation. It's to propel and steer space ships. The engine obtains its thrust by ionizing an inert gas—converting it to plasma—then accelerating it to tremendous speeds through electromagnetic force, achieving thrust. It operates indefinitely by battery and solar-cell power. See "Briefing the Record," p. 72.

Contents continued on following page

What's so complex about stainless tubing?



What's so complex about stainless tubing? Proper selection is. There are at least a million combinations of stainless grades, tube types, heat treatments, mechanical properties, physical properties, tube sizes and tube costs to choose from.

Only one combination of all these variables is right for your particular heat exchanger or condenser. Only one will deliver optimum efficiency, give longest service life at lowest operating cost, the one that is *matched* to the *job*.

Arriving at the proper stainless tube requires careful analysis of the application, also a perfect match of stainless tube properties to your service requirements.

This analysis requires the talents of your engineering staff. The match calls for a tubing specialist—a B&W district salesman or a Steel Service Center handling B&W stainless tubular products. Why not talk to one soon?

The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

B&W

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

TA-1016-S

Seamless and welded tubular products, solid extrusions, rolled rings, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

Circle No. 15 on Readers' Service Card

MECHANICAL ENGINEERING

PUBLISHED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Contents (continued)

VOLUME 83 • NUMBER 11 • NOVEMBER, 1961

Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at ASME headquarters, United Engineering Center, 345 East 47 Street, New York 17, N. Y. Cable address, "Mechaneer," New York. Price to members annually $3.50 for initial membership subscription, $5.00 for additional subscriptions, single copy 50 cents; to nonmembers annually $7.00, single copy 75 cents. Add $1.50 for postage to all countries outside the United States and Canada. Changes of address must be received at Society headquarters seven weeks before they are to be effective on the mailing list. Please send old as well as new address . . . By-Laws: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4) . . . Second-class mail privileges authorized at Easton, Penna. . . . Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921 . . . Member of the Audit Bureau of Circulation. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author and that date of publication be stated.

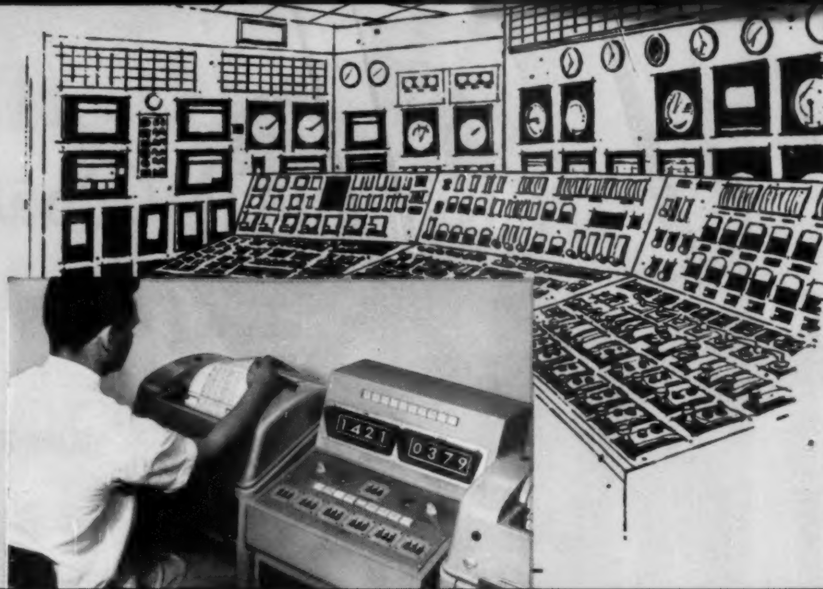
63,300 copies of this issue printed

MECHANICAL ENGINEERING is indexed by the Engineering Index, Inc.

Departments

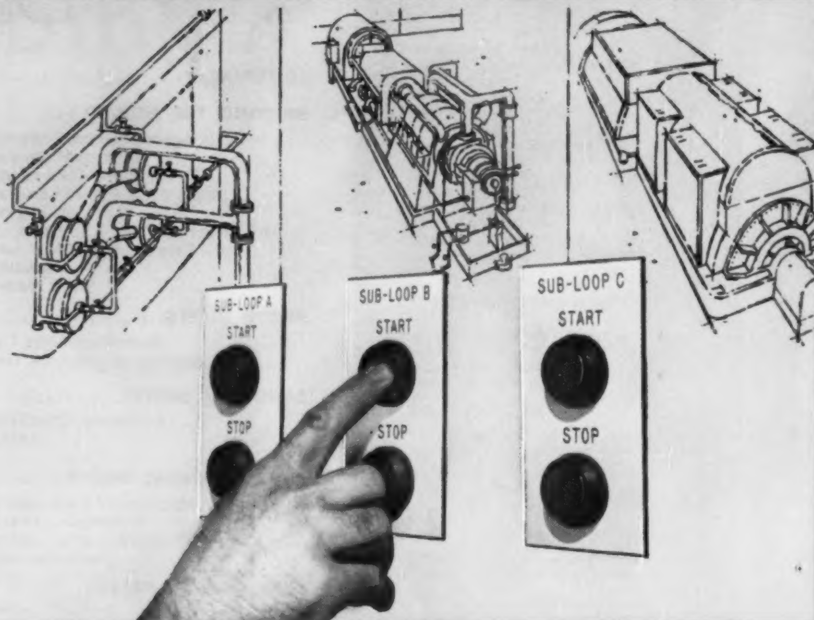
FIRST SIMPLIFY...

First step to automation is to *simplify* the information now presented by a multitude of multi-record charts, gages, and annunciator lights. The Bailey approach gives the operator data he needs (logged periodically), keeps continuous watch on all variables, makes calculations where required, alarms when trouble threatens. Reliability of recorded data is increased . . . operators can devote full attention to correcting off-normal conditions and improving operations.



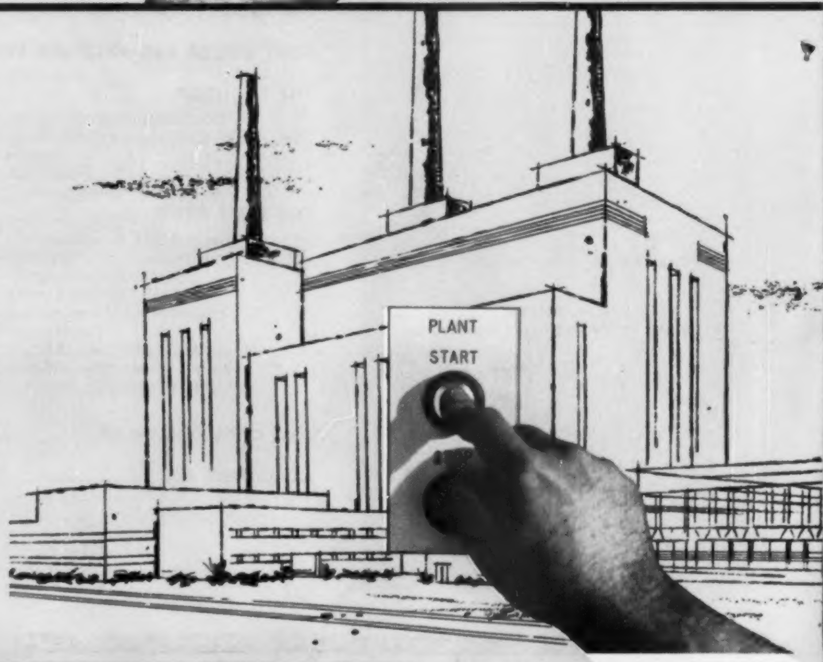
NEXT VERIFY...

Next, verify the practicability of automation by extending supervisory controls, letting equipment perform more operating functions. Automate key systems, one at a time, by push-button controlled sub-loops. This approach smooths the transition to complete automation and improves safety to men and machinery by providing safe, uniform start-up, shut-down, and normal operating procedures.



THEN AUTOMATE

Final steps to automation can then be made at any time with full confidence and proved operational experience. These steps are: 1) to consolidate supervisory controls, conventional controls, and sub-loops for full-range automatic operation once the plant has been placed on the line; and 2) ultimately, to add start-stop control to provide full automation.



How to get *assured results* from AUTOMATION

...and gain as you go

Complete automation is a long step forward — with many challenges along the way.

The Bailey step-by-step approach to automation makes possible step-by-step certainty ... provides step-by-step benefits ... requires only step-by-step commitment.

In the initial steps it makes possible many or most of the benefits of complete automation with considerably less investment than required for the ultimate. And it permits the decision to take each succeeding step to be made only after satisfactory evidence that it is economically justified and functionally sound.

Bailey 700 Systems draw on the best available techniques, including analog and digital manipulation, trend recording, time sharing, scanning, alarming, calculating, controlling, and logging, as required to meet operating objectives. Individual systems, including logic and sequence units, are coordinated by Bailey's distinctive method of *parallel programming* to achieve plant automation. The parallel-programming approach improves plant availability by making it practical to remove individual systems from service or reprogram without disturbing operation.

Ask your Bailey District Office, or write for more information on the Bailey step-by-step approach to automation with Bailey 700 Systems. Bailey Meter Company, 1026 Ivanhoe Road, Cleveland 10, Ohio. In Canada —Bailey Meter Company Limited, Montreal.

Bailey Systems Concepts are Founded on 45 years of Experience

Twenty-one of the twenty-six most efficient steam-electric stations in the United States use Bailey Instruments and Controls.* This reflects more than 45 years of Bailey developments devoted to improving the reliability of power-plant operation. **Listed in Federal Power Commission Report S-143.*

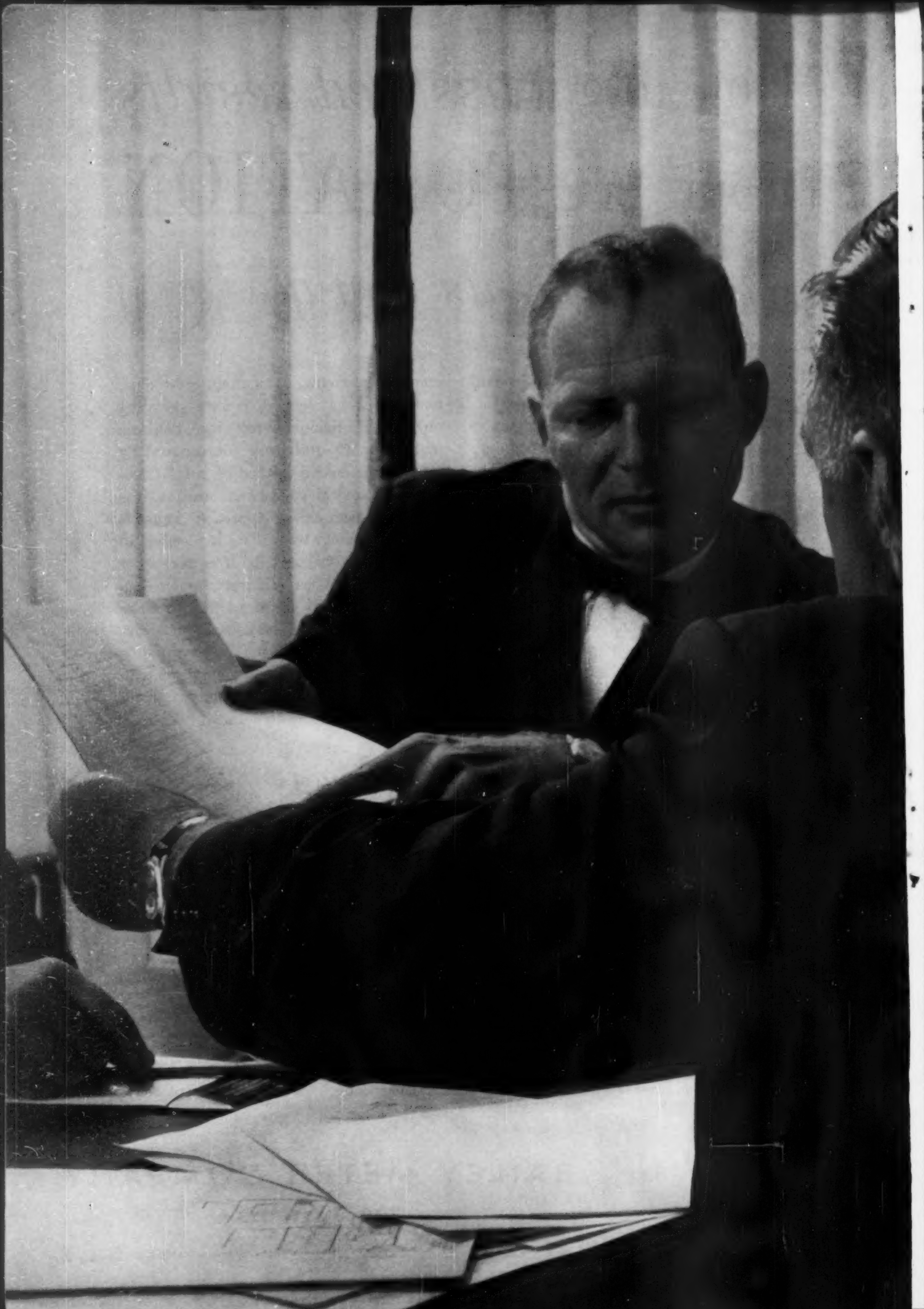
Bailey experience in automation dates from electrically operated boiler controls in 1924, automatic start of boiler controls on steam-electric locomotive in 1936, and fully automated package boilers in 1948. This Bailey 750 System for simplified display of power-plant operating information was installed in 1959.

Bailey experience extends to and includes the atomic power field. In the completion of the Enrico Fermi Atomic Power Plant at Monroe, Mich. in 1961, Bailey Meter Company was prime instrument contractor, supplying both pneumatic and transistorized electronic control systems. A165-2

BAILEY METER COMPANY

700 Systems

Circle No. 19 on Readers' Service Card



"Bob, the computer analysis says we should buy those parts instead of making them"

NEW CAPITAL INVESTMENT PROGRAM

Here's a new IBM computer program that's yours for the asking. Using the Investors Method (Rate of Return on Investment), it helps you evaluate—*quickly, economically, uniformly*—alternate proposals for spending your company's money.

The program will help you solve problems like these: should you buy a new piece of equipment or keep the old one in repair; should you increase your manufacturing facilities; should you buy or make certain products; how should you spend your money for research to make the most profit?

These are only a few of the problems that the Capital Investment Program handles. All it takes is the Program and an IBM computer that accepts FORTRAN programming language. The low cost IBM 1620 Data Processing System is one such computer.

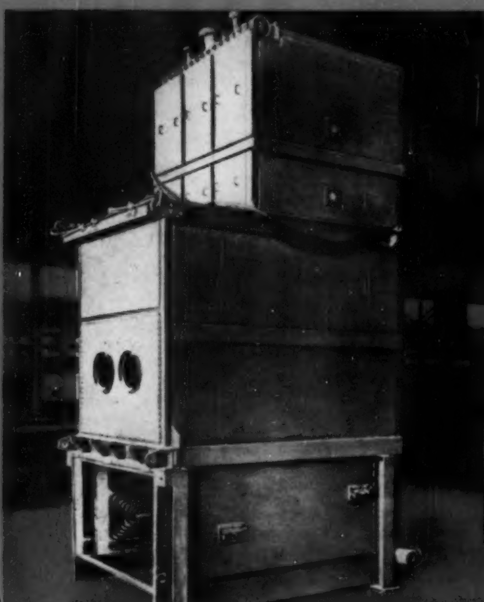
The new Capital Investment Program is another of the many problem solving programs IBM offers you to help make your data processing system a more effective and more profitable tool for managing your business.

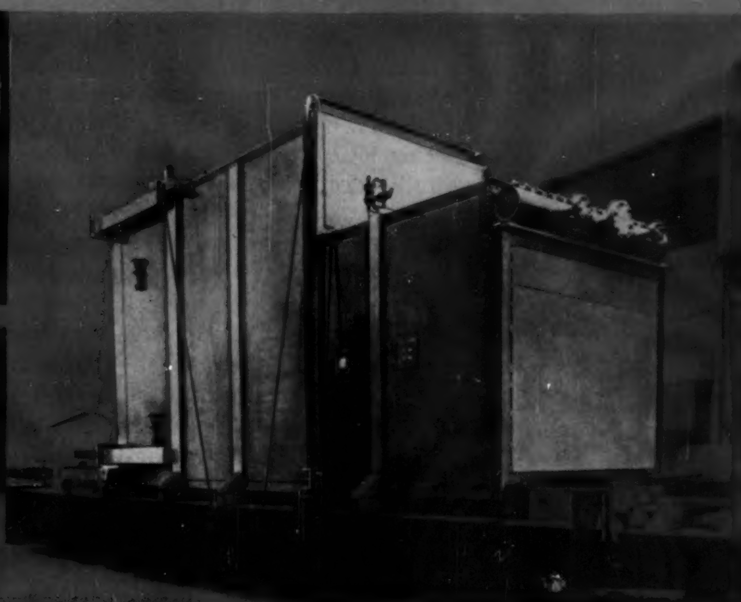
Your local IBM Representative can give you complete details on this, as well as previously announced programs, which included Sales Forecasting, Materials Planning, Inventory Management, Plant Scheduling, Work Dispatching, Operations Evaluation, Inventory Management Simulation, and many others.

IBM®
DATA PROCESSING

Circle No. 70 on Readers' Service Card

WATER BOILERS





3 A 25-million Btu unit completed with welded casing, ready for shipment. Cables are attached to lifting lugs.

4 Compact, completely shop-assembled units from 20 to 35-million Btu are shipped this way.

This C-E practice greatly reduces erection costs.

So, if you are in the market for boilers, either for space heating or process requirements, it may prove to your advantage to investigate the use of high temperature water as your heat source. Because individual needs vary, both steam and hot water have their place. Our engineers will be pleased to discuss either method with you or your consultants—impartially and with no obligation.

For further details on high temperature water boilers by C-E write for our catalog HCC-2.

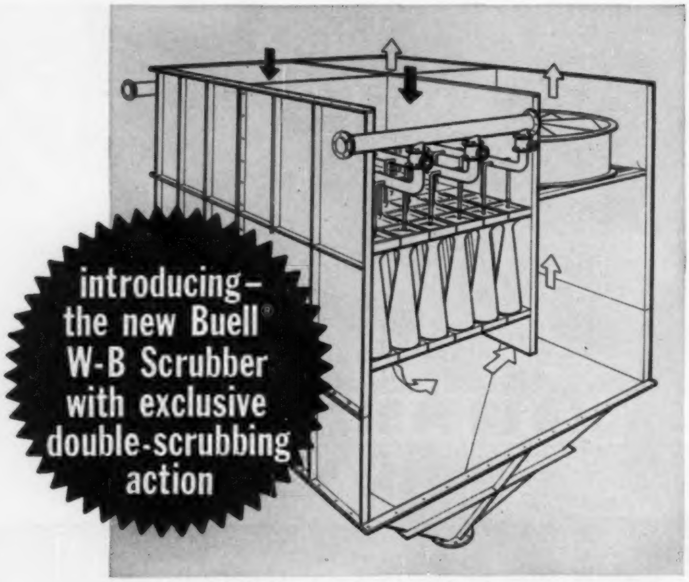
COMBUSTION ENGINEERING

C-306

General Offices: Windsor, Conn.
New York Offices: 200 Madison Avenue, New York 16, N. Y.
Canada: Combustion Engineering-Superheater, Ltd.

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

Circle No. 38 on Readers' Service Card

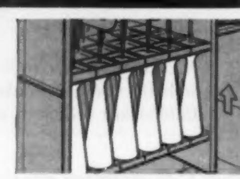


Service-proved in applications around the world, the new Buell W-B Scrubber is now available for sub-micron dust removal jobs in this country. This newest multi-venturi wet collector removes over 99% of dust as small as 0.05 microns. Licensed under the famous Waagner-Biro patents, the new Buell W-B Scrubber offers several distinct benefits over other wet collectors. The most important are discussed below. ■ There are other operating advantages, too, including low water requirements, and case-hardened venturi throat to resist erosion. But why not check into the Buell W-B Scrubber for your own application? For details, write Buell Engineering Co., Inc., Dept. S, 123 William St., New York 38, N. Y. ■ cyclones · electric precipitators · bag collectors · combination systems · classifiers · venturi scrubbers.

double-scrubbing action Exclusive! Water is introduced ahead of the venturi, which forms two distinct cones for gas to pass through

typical process industry uses sulphuric acid mist—detergent fumes—lime dust—catalyst dust—fly ash—fluorine compound dusts—hydrochloric acid fumes—cement dust—tar—acetic acid fumes—phosphoric acid mist—titanium dioxide dust—salt cake dust.

low power This special design achieves the desired efficiencies with low pressure drops; thus, requires minimum power ■ **high efficiency** The Buell W-B Scrubber offers efficiencies for given conditions higher than any similar system.



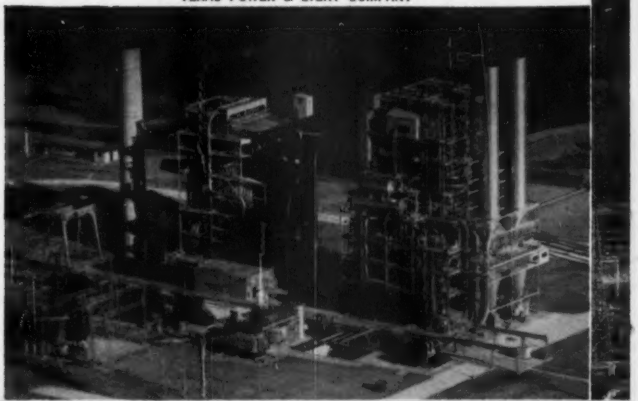
any capacity The new Buell W-B Scrubber is made up of multiple venturi tubes—each a standard, readily-stocked item. Capacity for your application is arranged simply by designing for the proper number of venturi tubes.

Member Industrial Gas Cleaning Institute

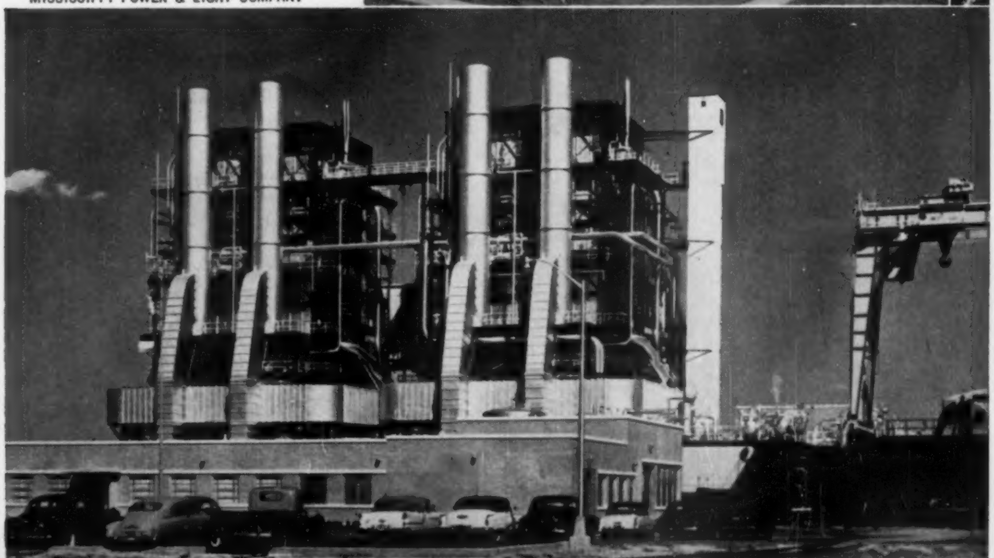
buell® Norblo®

Circle No. 26 on Readers' Service Card

TEXAS POWER & LIGHT COMPANY

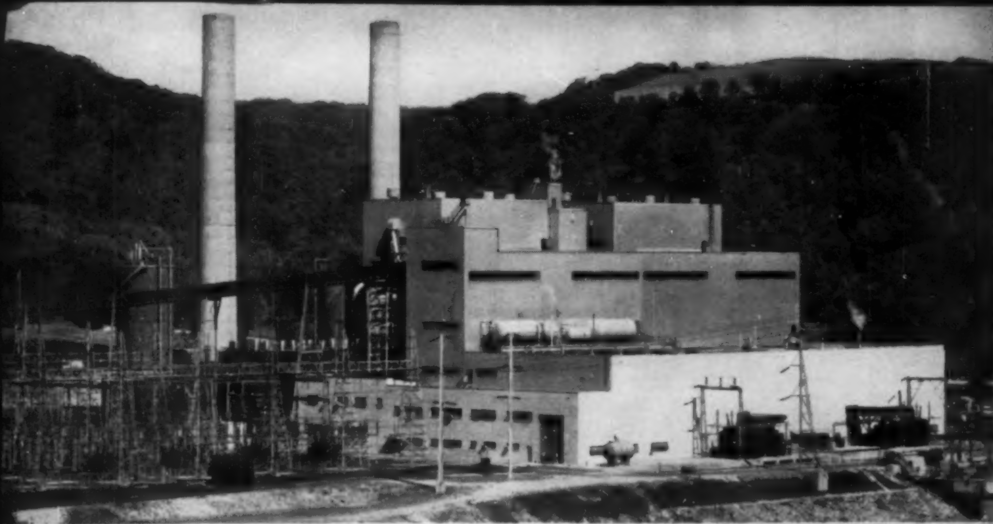


MISSISSIPPI POWER & LIGHT COMPANY

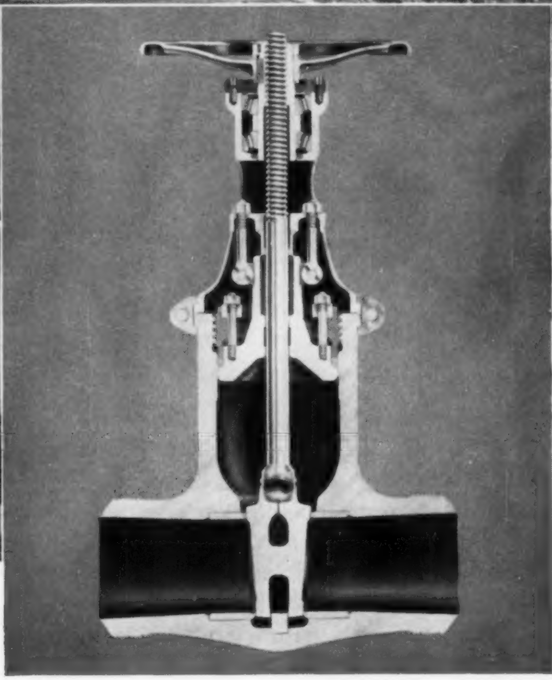


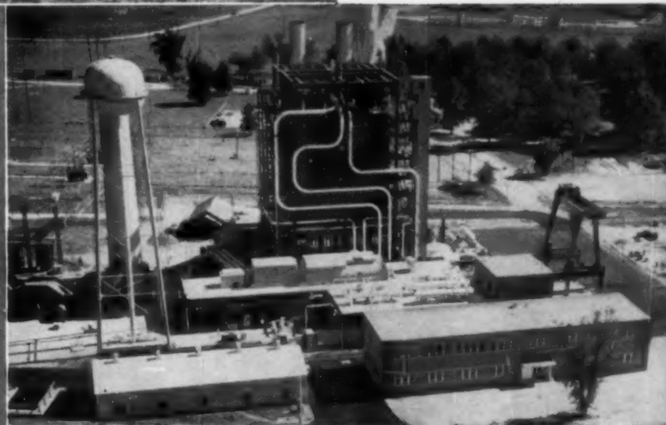
MINNESOTA POWER & LIGHT COMPANY

ARKANSAS POWER & LIGHT COMPANY



WEST PENN POWER COMPANY





LOUISIANA POWER & LIGHT COMPANY

Snap Experimental Reactor

DEVELOPING THE WORLD'S SMALLEST NUCLEAR REACTOR POWER PLANT

In the next decade, man will enter the vast new world of outer space. An important factor in his ability to fully utilize this new environment will be auxiliary electrical power. Atomics International is developing SNAP (Systems for Nuclear Auxiliary Power) reactors for the AEC which will generate many kilowatts of electricity, operate unattended for long periods in space and weigh only several hundred pounds.

Compact reactor projects at AI provide challenging opportunities for engineers and scientists interested in contributing to the practical utilization of space. Positions are available in the following areas:

Heat Transfer. Engineering analysis in the fields of heat transfer and fluid mechanics. Responsibilities will include systems engineering studies on the thermal, hydraulic and thermodynamic performance of advanced reactor systems.

Systems and Control Analysis. Analysis and simulation of complete nuclear power plants to develop reliable, unattended, automatic control and instrumentation systems, including reactor kinetics, dynamics, stability and thermal characteristics and reliability analysis.

Reactor Analysis. Complete nuclear thermal and structural analysis including criticality, flux and power distributions and fuel cycle analysis.

Reactor Operations Evaluation. To establish detailed operating procedures, direct operations, and evaluate the performance characteristics of compact, lightweight nuclear systems for space applications.

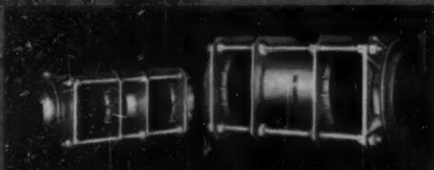
Metallurgical Development. Several years experience in the application and usage of high temperature radiation resistant materials, including the joining of these materials. For application to the development of advanced lightweight control systems, pumps, thermoelectric generators, etc.

Preliminary Design. Several years experience in reactor systems analysis and design with interest and ability in preliminary analysis and design of advanced nuclear systems for space and terrestrial uses.

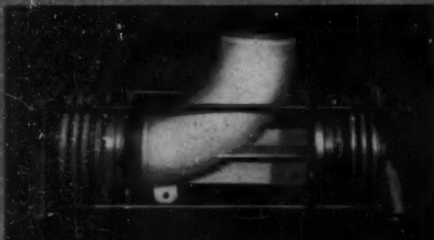
Please contact: Mr. A. L. Newton,
Personnel Office, Atomics International,
8900 DeSoto Avenue, Canoga Park, Calif.

All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

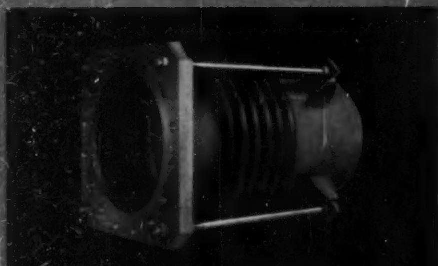
ATOMICS INTERNATIONAL
DIVISION OF NORTH AMERICAN AVIATION
Circle No. 97 on Readers' Service Card



This pair of universal expansion joints is installed in the vapor piping of a gaseous diffusion plant. The lines carry Freon 114 at pressures up to 500 psig and temperatures ranging from −20°F to 300°F. Joints accommodate 3" lateral movement under these extremely harsh service conditions.



A 12" pressure balanced elbow assembly specially engineered by Badger for use in LOX storage and transfer facilities at an Air Force Missile Base. The unit is designed to operate at temperatures from −297°F to 250°F — a thermal shock range of nearly 550°! Operating pressures vary from 0 to 150 psig. Joint movement: 0.8" axial, 0.15" lateral.



One of eight specially engineered Badger Expansion Joints at a power plant for a gas recovery unit in Texas. Installation is on a cooling water piping of the surface condensers where service conditions require operation at 55 psig at a temperature of 107°F. The joints are designed to absorb ½" lateral movement in combination with ¼" axial movement.

This 24" x 44½" I.D. rectangular expansion joint, connects the turbine and condenser at a steam power plant. Each of the units is designed to operate at a pressure ranging from full vacuum to 1 psig at a temperature of 360°F. The joint handles ⅛" axial compression and a plus or minus ⅛" lateral movement.

TOUGH JOINTS

— BADGER SPECIALTY

Anyone with the necessary manufacturing facilities can fabricate expansion joints. But it takes an *experienced* manufacturer to analyze tough piping problems properly and then provide the correct expansion joints to solve them. Badger, with more than 55 years in the field, has had more experience with a wider variety of special design problems than any other expansion joint manufacturer. Put this store of skill and knowledge to work for you — get the most effective and economical solution to your expansion joint problem. Call or write for complete information about Badger S-R Expansion Joints and our "on-the-spot" engineering service.

BADGER

MANUFACTURING COMPANY

230 BENT STREET, CAMBRIDGE 41, MASSACHUSETTS

Representatives in Principal Cities

Circle No. 17 on Readers' Service Card

1 HIGH-SPEED OPERATION
Balanced release levers permit high-speed drives. Lever "throwout" is eliminated for longer bearing life. Patented anti-friction rollers give instant release with minimum pedal pressure.

2 ACCURATE FIT
Close-tolerance drive between cover and pressure plate assures smooth starts. Highly accurate bolt circle fits flat flywheels—accurate outside pilot diameter fits counterbored flywheels.

3 VIBRATION DAMPENER
Coil-spring vibration dampener absorbs vibrations between engine and transmission. Noise, rattle and thrash in the gear train are eliminated for smooth, quiet clutch operation.

ROCKFORD SPRING-LOADED CLUTCH

International model C-130 Dump Truck equipped with Rockford Spring-Loaded Clutch

4 HIGH-TORQUE DESIGN
Powerful engagement springs, properly spaced over the facing area, assure maximum driving contact. Compact, low-inertia design prevents gear clashing and delayed shifting.

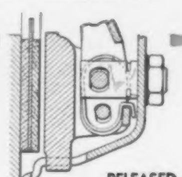
5 SMOOTH ENGAGEMENTS
Dynamic and static balancing assures you of smooth, enduring clutch performance. Both driving and driven members are balanced to eliminate vibration.

6 HIGH-TEST FACINGS
Using only the highest quality facings, Rockford Clutches give extra-long clutch life, provide cushioned starts, reduce scoring and greatly cut costs of downtime replacement and labor.

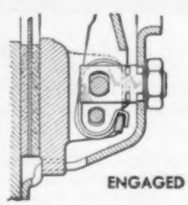
7 PERFECT ALIGNMENT
Close-tolerance splined hub assures perfect disc alignment. Through-hardened hub gives long life. Precision manufacturing and rigid quality control eliminate chances for misalignment.

7 Good Reasons Why Idea-Men Count on Rockford Reliability

Above are seven reasons why more and more design men specify Rockford Spring-Loaded Clutches. Equally important, ROCKFORD RELIABILITY is due to 63 years of creative engineering, precision manufacturing and rigid quality control. Rockford offers complete design engineering service at no cost or obligation. You're backed by a worldwide service network. Write today for complete details on ROCKFORD RELIABILITY.



RELEASED



ENGAGED

ROCKFORD CLUTCH

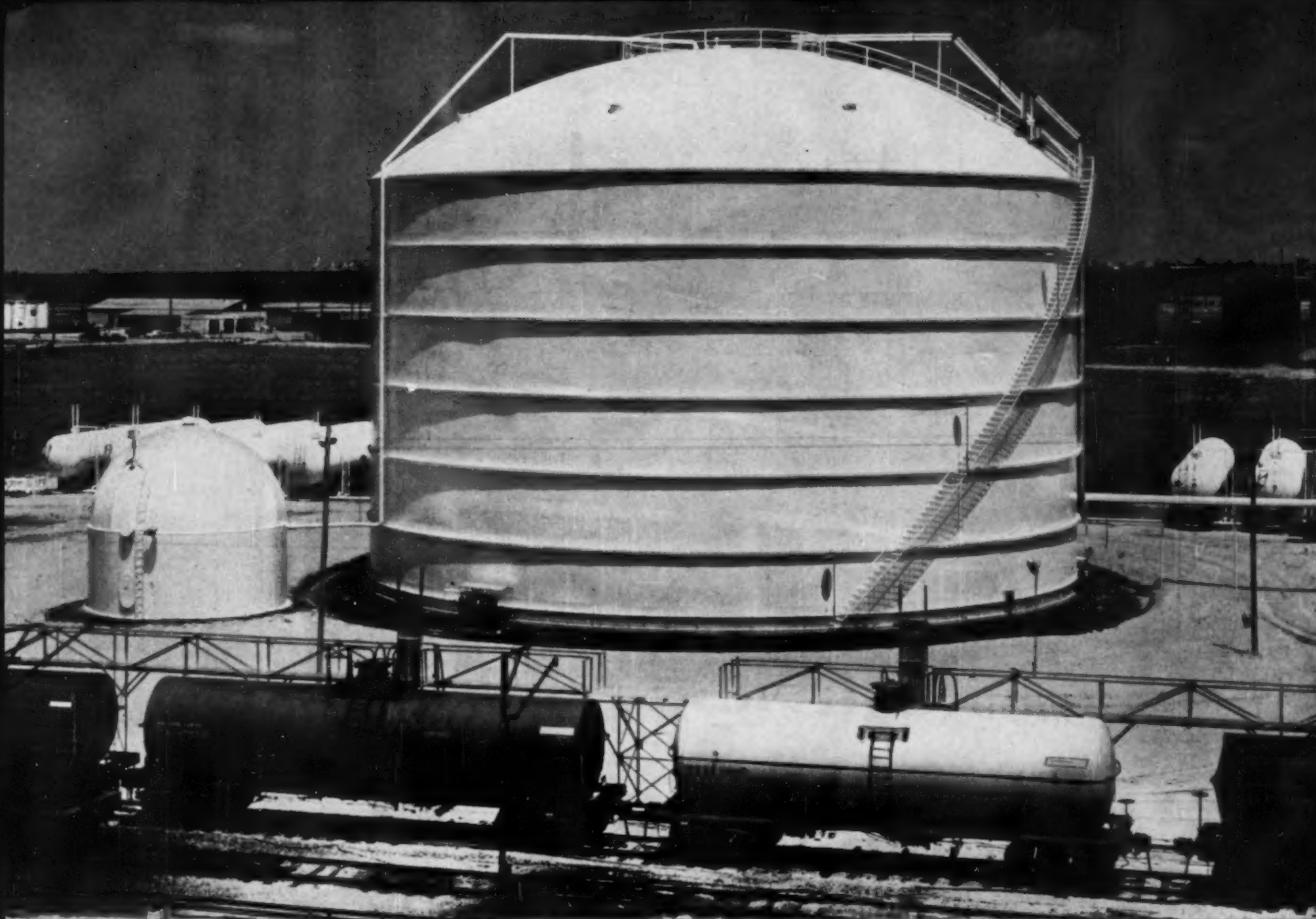
1219 WINDSOR ROAD, ROCKFORD, ILLINOIS

DIVISION OF BORG-WARNER

Export Sales Borg-Warner International • 36 So. Wabash, Chicago, Ill.

Circle No. 112 on Readers' Service Card

Compact Packaged Air Preheater being unloaded for installation on new 100,000 lb/hr boiler at Hoffmann-La Roche's Nutley, N. J. headquarters. In operation, it will increase the temperature of the combustion air 375°F—thereby increasing boiler efficiency by approximately 8%.



Another Cost-Saving Triumph for Refrigerated Storage of Anhydrous Ammonia

The key to efficient, economical storage of anhydrous ammonia at the Mid-South Chemical Co., plant in Memphis, Tenn., is this refrigerated storage facility designed and built by CB&I.

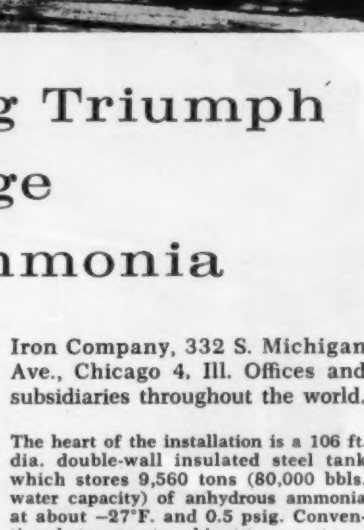
The economy of refrigerated storage facilities operating at atmospheric pressure (including operating and maintenance cost) has been proved many times in comparison with conventional pressure storage at ambient temperatures. Inherent safety features are built into the facilities.

This same economic benefit is available for "peak shaving" storage of liquefied petroleum gas and for gas production plants.

Single Responsibility is assured – from initial planning through all phases of designing, engineering, fabricating and constructing – when you choose CB&I to build your refrigerated storage facility.

As the leading designer of low-temperature storage facilities, CB&I has considerable information that can be of value to you. Write for Bulletin G-48. Chicago Bridge & Iron Company, 332 S. Michigan Ave., Chicago 4, Ill. Offices and subsidiaries throughout the world.

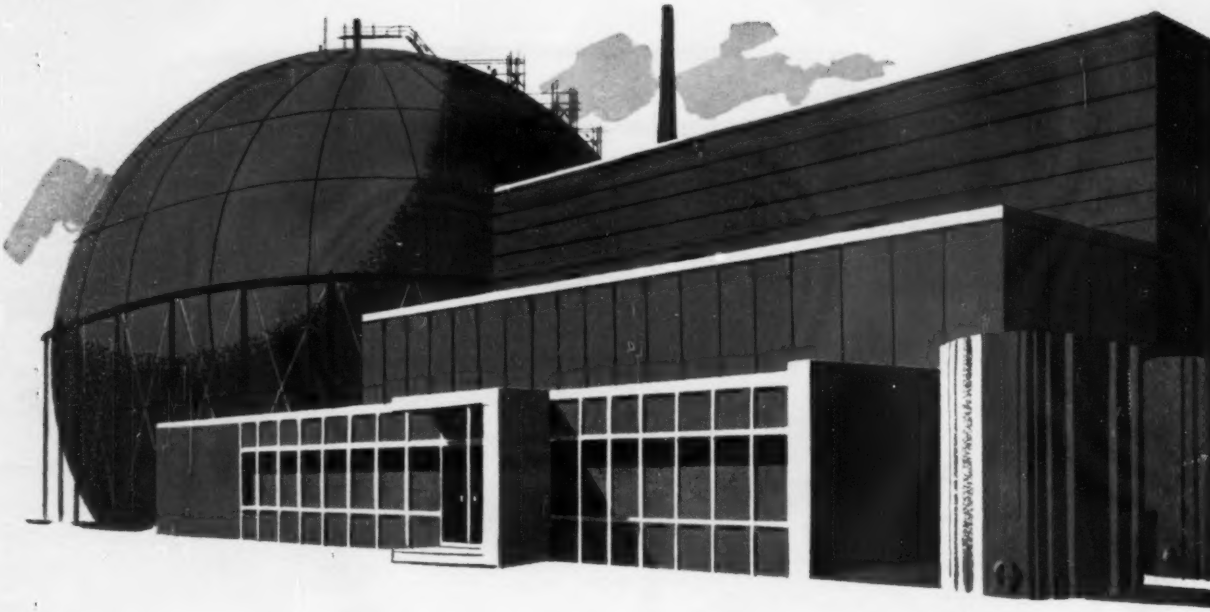
The heart of the installation is a 106 ft. dia. double-wall insulated steel tank which stores 9,560 tons (80,000 bbls. water capacity) of anhydrous ammonia at about –27°F. and 0.5 psig. Conventional storage at ambient temperatures would require 136 high-pressure 30,000 gallon blimps. Control is automatic – provided by a combination pneumatic-electrical system.

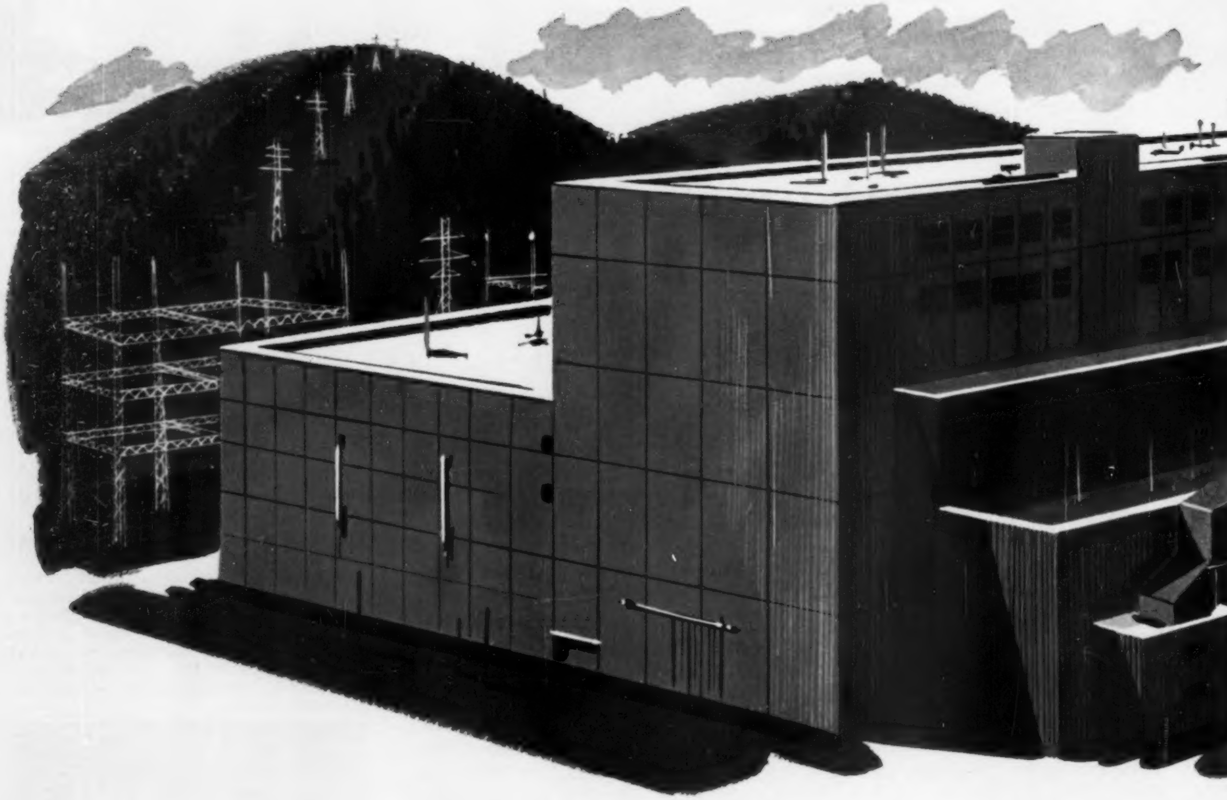


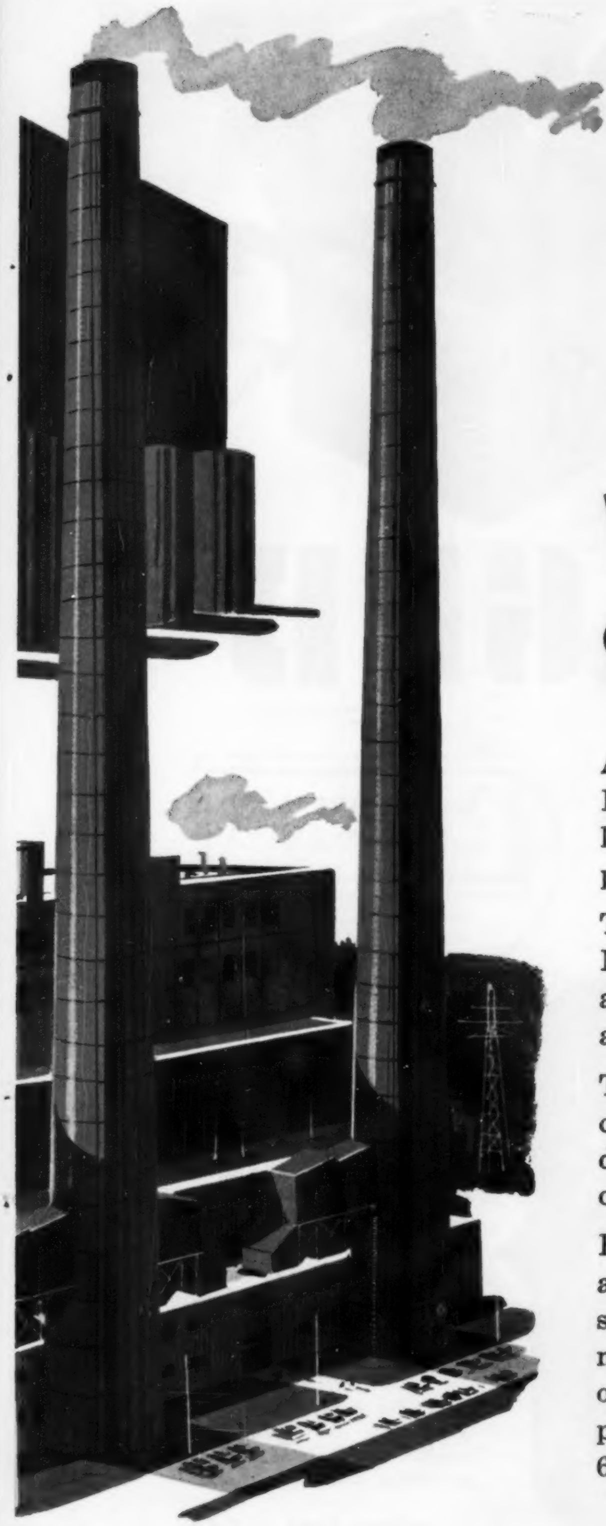
CB&I **built it!**

Circle No. 34 on Readers' Service Card

CB-6126







MECHANICAL ENGINEERING

VOLUME 83 • NUMBER 11 • NOVEMBER 1961

Staying Educated

THE rapid rate of change in engineering makes it crystal clear that both our engineering schools and our professional societies can no longer continue on a business-as-usual basis. They must organize themselves so that they can provide leadership that is sensitive to the changing requirements and demands made upon the profession. If they do not do so, they will join the dinosaurs as historical anachronisms.

We are quoting from an address which Dr. R. G. Folsom, Fellow ASME, and president of Rensselaer Polytechnic Institute, gave recently at the dedication of The Cooper Union's School of Engineering Building in New York, N. Y.

Dr. Folsom directed his remarks at the problems and challenges facing engineering education in the future.

Here, according to Dr. Folsom, are some problems that are concerning engineering education: How can we build into our curriculums the necessary elements and the necessary personal attitudes for a continuation and even an acceleration of the learning process throughout the student's professional life? What obligations do the engineering schools have in assisting the process of continuing education? When we award a student a diploma, have we finished with him or have we just begun? And if we have just begun, how are we going to finance the efforts that we must make toward his continuing education?

While he didn't attempt to provide complete answers to these questions, Dr. Folsom warned that . . . . we [educators] would be evading a major responsibility if we were to shrug off these problems by stating that we should do the best we can with the student while he is with us, and after that it is up to him.

An engineer needs to profit from the folk-lore flow of engineering knowledge, sometimes referred to as know-how, that comes from the give-and-take of fellow engineers and teachers. This has often been called corridor education, but we mustn't overlook its importance as a method of exchange of vital information. He needs the use of specialized libraries and of information storage-and-retrieval facilities to avoid needless and costly duplication of effort. New engineering information is accumulating so rapidly that it is becoming increasingly important to make this information readily available.

An engineer needs the cross-fertilization of ideas that comes from close association with men in related fields such as is provided by the professional engineering societies. In this respect, faculty members as well as students could benefit from the stimulation that comes from association with people with many different experiences and points of view.

Dr. Folsom concluded that we are going to have to educate more people faster and longer—almost certainly education will continue throughout people's professional lives. Somehow we must build into our profession greater responsiveness to new knowledge. And we must make education a full and participating partner with professional practice and research. Finally, we must always keep in mind the end result of our efforts—people—our most precious natural resource.

Both the engineering schools and professional societies should take heed of Dr. Folsom's remarks. Both play an important role in the making of engineers. But, getting back to the opening statement: Exactly how, for example, should ASME organize itself to meet the changing "requirements and demands made upon the profession"? And what can ASME do to "build into our profession greater responsiveness to new knowledge"? It's your Society. Let's hear from you.—*J. J. Jaklitsch, Jr.*

Editor, J. J. JAKLITSCH, JR.

Selling engineering

Like the "corporate image," engineering has an image within the company. Good

Why should we have to "sell" ourselves to corporate management? We are, after all, members of a profession. We do things logically and honestly. Furthermore, we can prove that we are right. The only problem is that these statements, although true, are slightly unrealistic because sometimes even logical proof meets with a rebuff.

Consider the case of the president who was prompt to make a decision but reluctant to reverse one. The chief engineer sent him a memorandum outlining a project that he wished to undertake. The memo was promptly returned with a red-penciled "no" above the president's initials. The chief engineer called on the president and outlined the matter in more detail. The president listened carefully, asked pertinent questions, and offered suggestions.

"Jack," he said finally, "what you propose makes a lot of sense. It's a good idea. It's really a shame that I said no."

Why was the first—and in this case final—decision "no"? When this happens, it may be due to the reputation that we have acquired from the day-to-day actions of our department. Our department's reputation is an outgrowth of the impressions that each of us makes individually and collectively in the various situations which are faced day to day.

The "Corporate Image"

A phrase has been coined to describe the process of getting your product sold and keeping your name in front of the public. They call it creating a corporate image.

By this is meant the whole process of public relations, industrial relations, advertising, and similar activities. This philosophy says in effect, "Your company has an image in the mind of the public that results from the over-all knowledge of what your firm does and has done, or at least what we, the public, hear and see." Therefore, why not go to the trouble of making it a good image and one appropriate to the product or service you offer?

This same philosophy does, in effect, apply to every organized group within the company as well. But as I do not like the term image too well, let us call it our "departmental personality."

What kind of a personality does your engineering department have? Are you known as leaders in new products, leaders in improving products or methods of manufacture, leaders in innovation, or leaders in showing new uses for products? In short, do you inspire your company into profit-making areas; or are you known as the ivory-tower boys, as an overhead department, as the reason that everything is behind schedule, or some other equally unimpressive appellation?

How does a department personality come to be? Who is responsible? Can it be changed? What difference does it make?

First, what difference does it make? A company to be strong, like a human body, must have balance. If engineering is important to the company's product or service, it should have a status equal to other major functions. It's hard for top management to give it that status if it gives an appearance that belies that station. Furthermore, internal morale and effectiveness reflect what others think of you and your department.

Departmental Personality

Departmental personality is—like the corporate image—the sum of many things: It is the general behavior of the staff among other members of the firm; the social behavior and extracurricular activities of the staff; internal departmental policy on communications, personnel affairs, expense accounts, travel, recognition. It is the type of communication with other departments and top management, the sense of optimism and enthusiasm shown by members of the staff, and also the quality of the product you design or the service you give.

Contributed by the Management Division and presented at the Summer Annual Meeting, Los Angeles, Calif., June 11–15, 1961, of The American Society of Mechanical Engineers. Condensed from Paper No. 61—SA-62.

By Donald E. Farr, Mem. ASME, President, H. B. Maynard and Company, Incorporated, Pittsburgh, Pa.

to management

or bad, the image is there, working for you—or against you—with management.

In fact, every contact that you and your associates have tends to develop some part of what others think of your activity.

Probably very few of us have ever put down on paper just what kind of "collective personality" we would like our department to have. Even fewer of us have taken advantage of the many ways to create this personality.

What should our objective be? Perhaps an aggressive one such as: "We can design anything you can sell; we can create a new product any time you need it. Bring in your problems and we'll solve them. We are the backbone of the company."

Or a conservative objective might be this: "Our engineering department is a key to company profitability on a par with any other major function of the company. We direct our efforts to those things which directly and indirectly contribute to this profit in a businesslike and economical manner. We aim to keep usable and prompt information on our work and designs in front of those who need it. We shall run our department along the same sound lines that prevail in our company as a whole."

Selling engineering and creating a favorable departmental personality are almost synonymous. They include an educational process—education for the engineers as well as education for other members of management.

In educating people to the merits of any service or product, there are three fundamental and basic precepts with which to start:

1 Know your product or service.

2 Have confidence and enthusiasm in it.

3 Know the maximum about your prospect—his limitations and strong points.

Let's start with "us"—the engineers. What is this service that we have which is important to others?

1 Creative brain power:

(*a*) Primarily oriented to product or service, but

(*b*) A potential source of broader managerial talents, providing we learn to manage our own activities.

2 "We" are a profitable investment because we are able to:

(*a*) Create new features to increase salability of company products.

(*b*) Create new products to invade new markets.

(*c*) Interpret customer demands in order to make sales possible.

(*d*) Devise ways to reduce product manufacturing cost.

(*e*) Devise ways to reduce maintenance cost.

(*f*) Create equipment to do new and better jobs.

(*g*) Find ways to improve product and/or service so as to be ahead of competition.

Let us examine how to insure that, first, we know our "profitable" features, and, second, pass them on appropriately.

Measure of Accomplishment

This calls for an objective analysis of the engineering activities and then pulling together some facts which represent these accomplishments. These facts must not be too cold, either. Statistics without explanation are rarely read. Each department and each company are somewhat different so that a detailed approach that is universal leaves much to be desired.

Engineering Profit Area. This heading is both factual and psychological. Think positively—remember that you contribute to profit, not to overhead. Some of the examples of engineering profit areas may be:

1 Modifications of basic design (without them a competitor would have the profit).

2 New products developed and put in production.

3 Cost reduction designs produced (new materials used, simplified manufacturing operations, and so on).

4 New production equipment designed which improves the product.

5 Competition-beating innovations.

6 Estimating and bidding (promptness and volume).

7 Maintenance studies either on product or plant.

Selling engineering to management

From this you may see that the first step is to make a thorough analysis of what you and your department are now doing and how it affects the business as a whole. It is possible that you may find some routine areas which have little relation to company profit and, in fact, do not need to be carried out by engineers.

Report of Accomplishment. This should be a condensed but descriptive statement of the results of the profit area it describes. When monetary values are reasonable in the description, they should be used. Remember that other more vocal members of the management team do not hesitate to mention their financial contributions. This may also indicate if separate reports have gone to management.

Profit Analysis. Here you may show if basis for an element is sales volume, product activity, elemental profit, or some other base used in determining that the activity was important to over-all company profitability.

Performance Standard. It is wise to think in terms of some type of objective for your elements such as: "bids are to be processed in two weeks," a manpower or money budget for certain activities, a specified number of drawings to be processed, or some other appropriate indicator of performance.

Action on Variance. Where performance is below standard, some action must be taken if you are to be a good engineering manager. This action can be anything from changing the standard to shuffling manpower. With this analysis as an example, you can devise modifications to suit your situation. The important point is to get a good understanding of your own operation, its strong and weak points, and how it contributes in specific areas to the company's profit picture.

Know Your Prospect

Now: Armed with this we look at our second premise, "know your prospect." Generally, we are speaking of the man we work for—the boss. Sure we know him. When he has a bad golf game we stay away. When his eyebrows twitch, it's time to have urgent business back in the office, and so on.

We must look deeper than this. We need to try to put ourselves in his place, subject to the pressures and strains from many places—a busy man whose greatest problem is "too little time."

What basically motivates him? Profit most certainly, but there are many other factors which have an effect. Pride is important, both in his success and that of the company, and, being short of time, he cannot ferret out from verbose, lugubrious, and involved reports what basic facts are important.

Some managers like charts and some don't. This you have to know. Take the data that you have produced, boil it down, make it look interesting, and personally present it to your top manager. From this, get an idea of those things which help him, and improve your presentation next time. Try to get the feel of his problems and how you can help him do a better job by knowing important facts about your work.

Learn the following steps which are essential to influencing people:

Preparation or Make-Ready. Develop a full and complete knowledge of what it is you are providing to your company. Evaluate its worth in terms of the management and company, not in your terms.

Present the Benefits First. Show the accomplishments of your engineering service and how they are an advantage to the company. If you are planning on asking for an increase in budget, emphasize the gains to be made by the additional investment, but be honest and conservative. Give a brief dissertation on the facts and operation of your department, how you have made some of your accomplishments, and how they tie to other programs you are presenting.

Answer Objections. Invariably there will be doubt or some questions on parts of your story. He may question benefits, he may question facts, or he may just be emotional without specific reason.

Here is where the professional engineer often meets his Waterloo.

Now you can really show your metal. Take his objections one by one and, using the thorough knowledge you have acquired in your make-ready, point out how these objections are in error. Too often an engineer gets in a huff if his professional actions are challenged, particularly by a nonprofessional. He puts on a take-it-or-leave-it attitude instead of calmly and objectively going over the points in question.

Professional pride is important but not infallible, and an occasional compromise to meet other equally important needs is a great help. Present your case wisely and patiently.

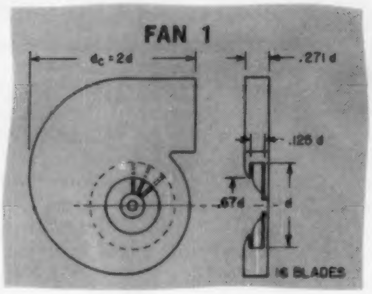
Get a Decision. Again, we are prone to leave the results of our meetings up in the air. If we are only presenting facts of our department for "educational" purposes, no major decision is needed. But, even so, it is best to get an indication that he agrees with what you told him. The "I'll think it over" close of a discussion is OK if a definite deadline is established for completing the "thinking over" process and rendering a verdict. But always try to complete the discussion in such a way that there is no doubt in anybody's mind about what steps must be taken next.

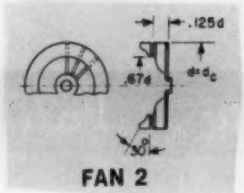
As engineers, we must constantly keep in mind, along with our professional skills, a recognition of the needs of the man to whom we report. Perhaps he doesn't even completely recognize these needs. If we remember this and remember the steps we must take to have adequate knowledge in the proper form, there are many opportunities to put our story across. In this way we will all do better in our profession.

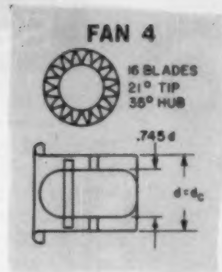
Conclusion

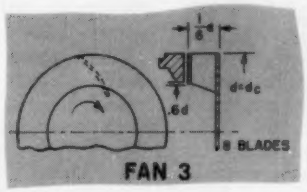
I hope that you will resolve to think positively in terms of the profitability and importance of your work as engineers. Not just a hollow pride, but one that we can reinforce with fact. Let us actively and discretely promote the idea "that our engineering department is profitable" to everyone and every division in an entire company.

Finally, if engineering is to achieve high professional status and the respect that is due it, we must analyze those with whom we must work, put our benefits and personal "promotional" activities in his terms and not ours. If we do this, a new level of recognition will be forthcoming—a rich and rewarding one. For in truth, we are only as good as others believe us to be—and this applies to every area of human endeavor.

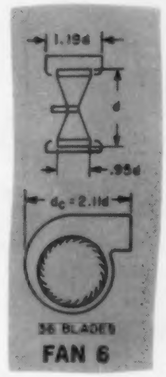


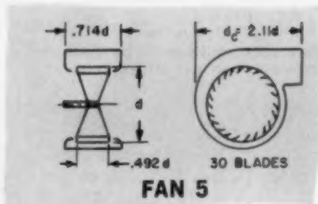




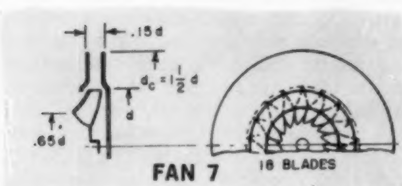


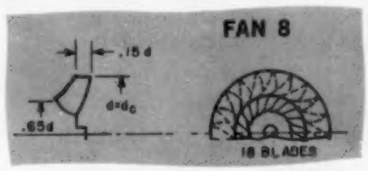
Selecting a Fan

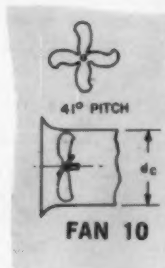


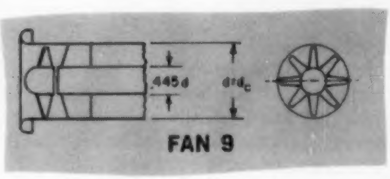


By N. J. Lipstein,[1] Assoc. Mem. ASME
General Electric Company, Schenectady, N. Y.









For electrical equipment, and such applications as air conditioners, vacuum cleaners, and heat exchangers, you may want to calculate the smallest fan — or the lowest rpm — for a given flow. Here are the methods of sizing a fan system.

A FAN can be found in virtually every piece of electrical equipment. Many engineers who are exposed to fan selection or design have little background in fluid mechanics. A correlation will be presented which can be used to select a fan design for a given set of requirements without resorting to any generalities or rules of art.

Specific Speed. Specific speed is a dimensionless number which is defined in terms of the fan head flow and rpm [1, 2, 3, 4].[2] Expressed in fan variables commonly used, the specific speed can be written

$$N_s = n \frac{Q^{1/2}}{(\Delta P)^{3/4}} \left(\frac{\rho}{0.075}\right)^{3/4} \tag{1}$$

where the fan head has been replaced by the pressure at a standardized inlet air density of 0.075 lb per cu ft. By the use of Eq. (1) each point on the pressure-flow per-

[1] Fluid Mechanics Engineer, General Engineering Laboratory.

[2] Numbers in brackets indicate References at end of paper.

Contributed by the ASME Hydraulic Division and presented at the Joint Hydraulic Conference, Montreal, Que., Canada, May 7–10, 1961, of the Engineering Institute of Canada and The American Society of Mechanical Engineers. Condensed from ASME Paper No. 61—Hyd-6, originally entitled "A Correlation of Fan Performance for Solving Selection Problems."

Selecting a Fan

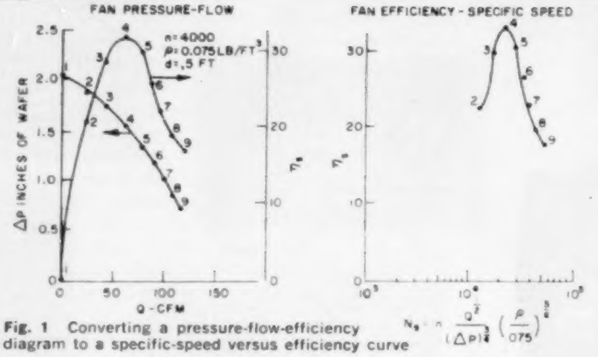


Fig. 1 Converting a pressure-flow-efficiency diagram to a specific-speed versus efficiency curve

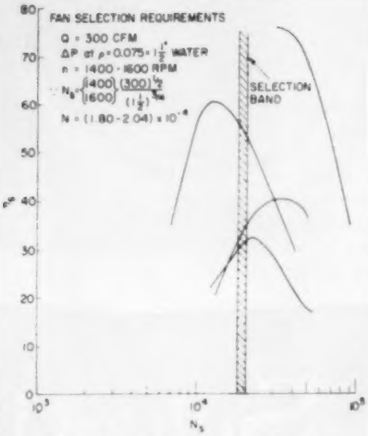


Fig. 2 Selecting a fan on the basis of efficiency at design specific speed

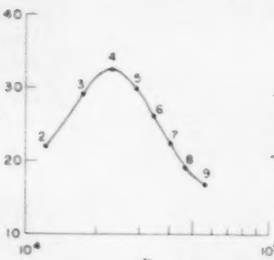
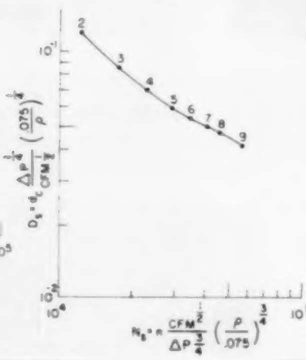


Fig. 3 The pressure-flow curve of Fig. 1 converted point by point into a Ds-Ns plot



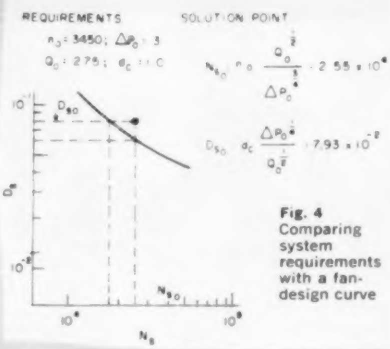


Fig. 4 Comparing system requirements with a fan-design curve

formance curve of a fan can be expressed in terms of its corresponding specific speed. By plotting the static efficiency versus specific speed, a useful selection curve is obtained. It can easily be seen that the specific speed will range from zero to ∞ as the fan performance curve ranges from 0 flow to 0 pressure. However, as shown in Fig. 1, only a narrow band of specific speeds correspond to usable efficiencies and this band of values can be used to characterize the performance of each fan design. Within broad limits any fan of one design will operate over the same range of specific speeds independent of the scale of the fan. Thus by grouping a set of performance requirements in terms of a required specific speed and comparing this with the specific speeds of various fan types, the most appropriate choice can be made, Fig. 2.

Specific Diameter. Specific speed defines the rpm required of a fan design to generate a certain pressure-flow performance without explicitly considering fan size. To define the fan size required to produce the desired pressure-flow without explicitly considering rpm, an additional parameter can be defined which will be called specific diameter, D_s [9].

$$D_s = d_c \frac{(\Delta P)^{1/4}}{Q^{1/2}} \left(\frac{0.075}{\rho}\right)^{1/4} \tag{2}$$

d_c is a linear dimension of the fan which is pertinent to the particular selection problem.

The particular dimension used to describe the fan size is quite arbitrary. However, it is convenient to standardize on one definition so as to simplify the comparison of fan data.

To select a fan to fit in a specified compartment it has proved convenient to standardize d_c as the side of a square in a plane perpendicular to the axis of rotation which will just enclose the fan and housing. With this definition, fans with and without diffusers or scrolls may be compared and the optimum combination of fan rotor and housing determined, Fig. 6.

The performance data of any fan can be converted

point by point into specific-diameter values in a manner analogous to computing specific speed. By plotting the specific diameter versus the corresponding values of specific speed, a curve is obtained which explicitly describes the ability of that fan design to provide pressure and flow within the bounds of any space or rpm limitation. The conversion of a typical fan-performance curve in terms of pressure and flow into specific diameter and speed is illustrated in Fig. 3. The fan static efficiency is also included in the plots because of its obvious role in fan selection.[3]

Simple Relations in the N_s-D_s Plane

Solution Point and Fan Curve. The specific variables are used primarily to determine the ability of fans to perform within a set of rpm and space restrictions. They are uniquely suited because they are both separable with respect to and linearly dependent on rpm and size. In preparation for fan-selection excercises some of the fundamental relations in the N_s-D_s plane will be examined.

For simplicity, consider first only a single fan design in relation to a specified pressure,[4] flow, rpm, and maximum characteristic diameter. By means of Eqs. (1) and (2) these four specifications convert into a single point in the N_s-D_s plane. This point is then compared with the fan-design curve also plotted in the N_s-D_s plane to determine if the design is applicable, as illustrated in Fig. 4. If the specification point falls below the fan-design curve, a solution is unobtainable. When the solution point falls on the fan curve, the characteristic diameter of this particular fan design is just equal to the specified maximum. If it falls above the fan curve, the fan diameter will be less than the specified maximum. Since D_s is directly proportional to fan diameter, the required fan size is obtained by a simple proportion of the D_s intercept along the fan curve to the D_{s0} solution-point value. The procedure is illustrated in the following, using the values corresponding to Fig. 4.

$$d_{c\,\min} = d_{c0}\frac{D_s\,(\text{intercept})}{D_{s0}} = 1 \times \frac{6.00 \times 10^{-2}}{7.93 \times 10^{-2}}$$

$$d_{c\,\min} = 0.756$$

Thus the intercept of a constant-specific-speed line through the solution point and the fan curve yields the smallest fan operating at the desired rpm which will meet the pressure and flow specifications.

The fan running at the lowest rpm, rather than the smallest fan, is obtained from the intercept of a constant D_s line through the solution point with the fan curve. The fan prorated from this point will just be equal to the maximum specified size and run at the lowest rpm which can develop the desired performance with the design in question. The minimum rpm can be found immediately by the ratio of the intercept to solution-point specific speeds times the solution-point rpm. For the example of Fig. 4 the minimum rpm is

$$N_{\min} = n_0\frac{N_s\,(\text{intercept})}{N_{s0}} = 3450\,\frac{1.7 \times 10^4}{2.55 \times 10^4}$$

$$N_{\min} = 2300$$

[3] In the original paper the author explained the basis of derivation of the terms N_s and D_s. He showed that this representation requires that fan performance be independent of changes in Reynolds number and Mach number.

[4] The pressure specification will hereafter be assumed to be given at 0.075 lb per cu ft inlet density.

The examples illustrate the manner of determining the smallest size or lowest rpm fan of a given design which will deliver a certain pressure flow. However, intermediate solutions between these extremes can be obtained by prorating any point along the fan curve between the horizontal and vertical intercepts through the solution point.

Variations of N_s-D_s Along a Square-Law Resistance. In many fan applications the load approximates a square-law resistance, that is, the pressure required by the load is proportional to the square of the flow. The flow through the fan and load system stabilizes at the intercept of the fan and load curves. Since this type of load occurs so frequently, it will be helpful to consider the geometry of this load line in the specific-variable plane.

A square-law load can be represented as[5]

$$\Delta P = KQ^2 \tag{3}$$

where K is a constant.

If two points 1 and 2 along this load are considered, the pressures will then be related as

$$\frac{\Delta P_1}{P_2} = \left(\frac{Q_1}{Q_2}\right)^2 \tag{4}$$

Now comparing the specific speed and diameter corresponding to points 1 and 2, there is obtained by means of Eqs. (1), (2), and (4)

$$\frac{N_{s1}}{N_{s2}} = \frac{n_1Q_2}{n_2Q_1} \tag{5a}$$

$$\frac{D_{s1}}{D_{s2}} = \frac{d_{c_1}}{d_{c_2}} \tag{5b}$$

These relations are further simplified by considering variations of pressure and flow in terms of a fixed size and rpm requirement. Eqs. (5) are then reduced to

$$\frac{N_{s1}}{N_{s2}} = \frac{Q_2}{Q_1} \tag{6a}$$

$$D_s = \text{const} \tag{6b}$$

Thus in the N_s-D_s plane, the load line is simply a straight horizontal line (at constant D_s). The D_s value for the entire line can be determined by inserting the pressure and flow requirements for any one point. Values along the line at lower specific speeds correspond to higher flows through the load and at higher specific speeds to lower flows.

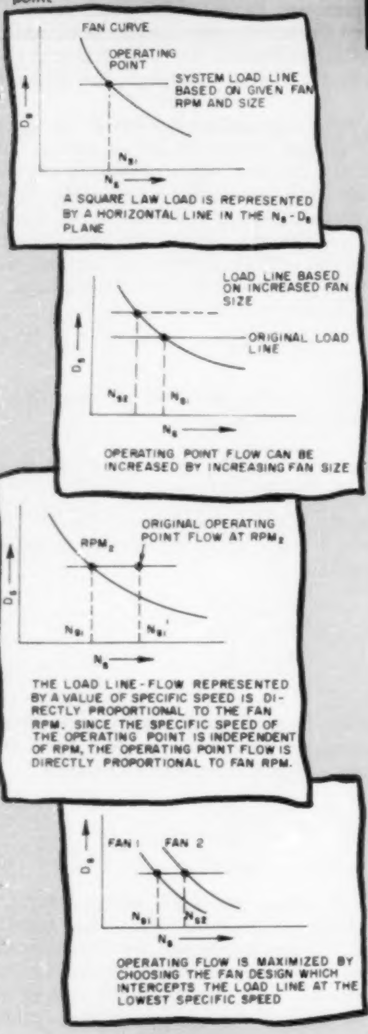
A frequent fan problem involving a fixed load is the desire to obtain an increase in flow starting from some base point. This situation can be explicitly described in the N_s-D_s plane. As a starting point, it is assumed that a fan has been tested and the fan performance curve as well as the operating point with the system load is known. Fig. 5*a* illustrates the geometry in the N_s-D_s plane.

There are in general three methods of increasing the flow through the load: (*a*) Increasing the fan size, (*b*) increasing the fan rpm, (*c*) changing the fan design. Each will be considered in turn.

Since D_s and fan size are directly proportional, an increase in fan size simply shifts the constant D_s load line a corresponding increment. Such a change is shown in Fig. 5*b*. The load line now intercepts the fan curve at a lower than original value of N_s which from Eq. (6*a*) indicates an increased flow.

[5] As previously, ΔP corresponds to the pressure required at fan-inlet density of 0.075 lb per cu ft.

Fig. 5 A frequent fan problem involving a fixed load is the desire to obtain an increase in flow starting from some base point



Selecting a Fan

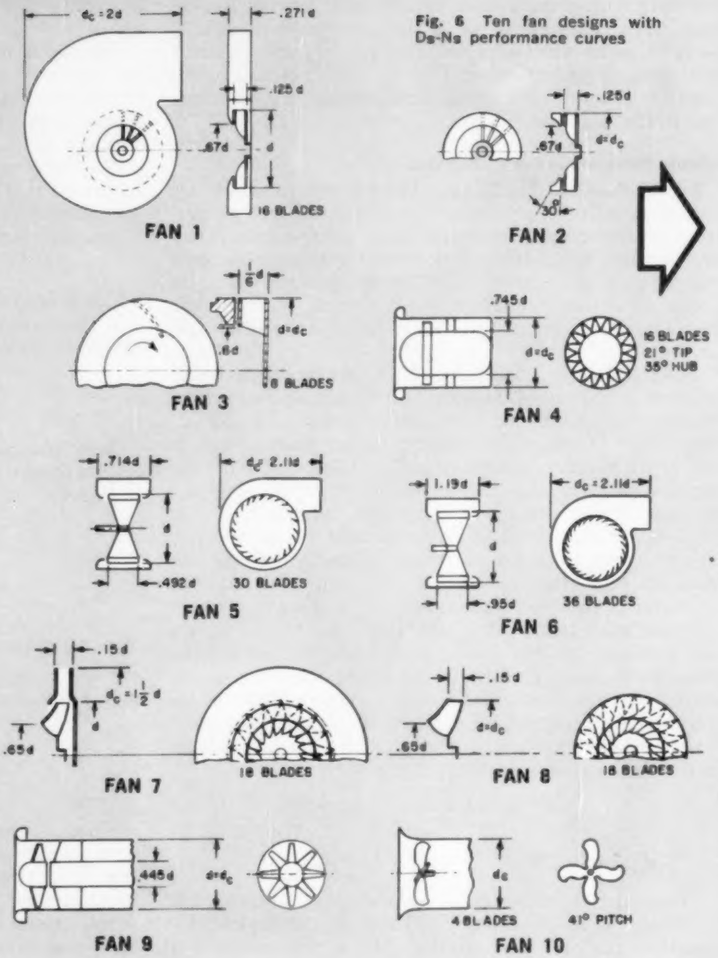


Fig. 6 Ten fan designs with Ds-Ns performance curves

If it is possible to increase the rpm of the original design, the system flow will increase in direct proportion to the rpm. That this is the case is immediately evident from Fig. 5*c* and Eq. (5*a*). Since the location of the load line is independent of rpm, the interception of the load line and fan curve remains constant with rpm. Thus $N_{s1} = N_{s2}$ and substituting this condition into Eq. (5*a*)

$$\frac{\text{cfm}_1}{\text{cfm}_2} = \frac{n_1}{n_2} \tag{7}$$

If it is not possible to increase the rpm or fan size, an increase in flow requires a superior fan design. By comparing several fan designs in the N_s-D_s plane the fan curve which intercepts the load line at the smallest value of specific speed will give the highest flow. This comparison is shown in Fig. 5*d*. Then Eq. (6*a*) can be used to obtain the flow which the new design develops.

Typical Fan Curves. Ten fan curves representing a spectrum of centrifugal and axial fans are presented in Figs. 7*a* and 7*b*. The data are based on tests made within the writer's Company, Ref. [5], and manufacturer's literature. This information is presented only to illustrate the specific-speed specific-diameter correlation. In some respects the data from various sources are not comparable and should not be used for design purposes.

Method of Solution in D_s-N_s Plane. Having acquired a number of fan curves, selection problems can be readily solved. Problem requirements in terms of size, rpm, pressure, and flow need only to be converted into a geometric region in the D_s-N_s plane and be superimposed upon the fan-design curves. Those portions of fan curves which lie within the requirement region represents a fan which meets each of the specifications. The fan design and the particular point along the fan curve which is chosen may depend on efficiency, availability, or

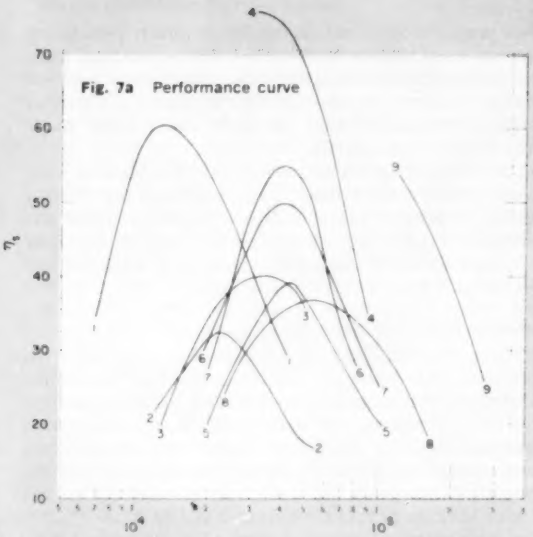


Fig. 7a Performance curve

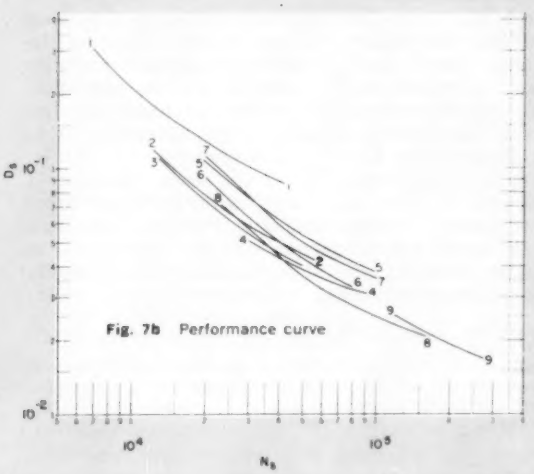


Fig. 7b Performance curve

noise considerations. (In the original paper, the author included three examples to illustrate the method.)

General Considerations Based on the D_s-N_s Representation

The designs which form the locus of minimum D_s values at any particular N_s will satisfy the largest number of specifications in terms of pressure-flow performance and minimum-size requirement. Thus one criterion for evaluating a new design might well be its performance curve in the D_s-N_s plane relative to the minimum D_s locus of previous designs.

In addition to problems in terms of specific flow and pressure requirements, any function in terms of powers of fan diameter and rpm can be simply represented in the D_s-N_s plane and compared with fan curves.

An interesting application of this technique is to express the sound generation of a rotor as proportional to $(\text{size})^7 \times (\text{rpm})^5$ as suggested in Ref. [7] and superimpose lines of relative sound generation on the D_s-N_s plane. This relation can only be used to compare fans of similar design. With this limitation the conclusion is reached that those designs of any one type which form the minimum D_s locus curve will have minimum sound generation for any application. This criterion would indicate that fan design 6 would be quieter than design 5 when each is sized to produce the same pressure and flow. The experimental work of Goldman and Maling [8] leads at a similar conclusion for this type of fan.

Conclusions

The correlation of fan-performance data in terms of specific diameter and specific speed greatly facilitates the selection of a fan to meet a set of size, rpm, pressure, and flow requirements. The use of the specific-variable plane is particularly helpful in the initial sizing of a fan system since it is possible to rapidly determine the size, rpm, and efficiency of the various fan types which can satisfy a given performance. The fan data collected suggest a minimum in possible D_s values for any N_s. Those fans which comprise this minimum D_s locus have the potential of satisfying the largest number of fan applications and of generating the minimum noise. (Since submitting this paper, it has come to the author's attention that the parameter D_s is similarly introduced in Ref. [9].)

Fan staging both in series and in parallel has been suggested as a method of penetrating the minimum D_s locus and the relations governing staged fan in the D_s-N_s plane have been given.

Nomenclature

d = rotor diam, hydraulic diam, ft
d_c = characteristic diam of fan package, ft
D_s = specific diam $d_c \dfrac{(\Delta P)^{1/4}}{(Q)^{1/2}} \left(\dfrac{0.075}{\rho}\right)^{1/4}$
K = const
n = rotor rpm
N_s = specific speed $n \dfrac{(Q)^{1/2}}{(\Delta P)^{3/4}} \left(\dfrac{\rho}{0.075}\right)^{3/4}$
ΔP = static pressure developed by the fan, in. of water
Q = volume flow through the fan, cu ft per min
ρ = weight density, lb per cu ft

Subscripts

0 = refers to requirement conditions
1,2 = specific fan designs or rating points, etc.
η_s = static efficiency

References

1 G. F. Wislicenus, "Fluid Mechanics of Turbomachinery," McGraw-Hill Book Company, Inc., New York, N. Y., 1947.

2 B. Eck, "Ventilatoren," Springer-Verlag, Berlin, W. Germany, 1952.

3 A. J. Stepanoff, "Turboblowers," John Wiley & Sons, Inc., New York, N. Y., 1958.

4 C. H. Berry, "Flow and Fan," The Industrial Press, New York, N. Y., 1959.

5 B. Eckert, "A Collection of Compressor Test Results," FKFS Report No. 10, 1276/7 PB 28688, distributed by Office of Publications Board, Department of Commerce.

6 C. J. Fechheimer, "Centrifugal Fans for Electrical Machinery," *Trans. ASME*, vol. 46, 1924, p. 287.

7 C. M. Harris, "Handbook of Noise," McGraw-Hill Book Company, Inc., New York, N. Y., 1957.

8 R. B. Goldman and G. C. Maling, "Noise From Small Centrifugal Fans," *Noise Control*, vol. 1, November, 1955, p. 26.

9 O. Cordier, "Aehnlichkeitshedingungen für Strömungsmaschinen," *BWK*, Band 5, 1953, pp. 337–340.

NEW NICKEL ALLOYS FOR HIGH-TEMPERATURE SERVICE

Wanted: Metals to hold steam at temperatures above the present practical limit of 1050 F. Must combine good rupture and tensile strength, ductility, and structural stability.

By T. E. Kihlgren[1]

International Nickel Company, Inc., New York, N. Y.

One problem found in all the latest power-producing developments is finding metals that will withstand high operating temperatures and stresses. At present, most of the steam industry is at the 1050 F plateau, and has adopted a "wait and see" attitude until some more reliable metals come along.

As part of its program to develop suitable materials for the higher temperature ranges, the International Nickel Company is developing several alloys which meet the requirements of high-temperature operation. The following will show the composition and some of the properties and uses of these new alloys.

Nickel-Base Alloy

The first of these alloys is a nickel-base material with 15 per cent chromium to supply oxidation resistance. The matrix is further alloyed with solid-solution hardeners. Table 1 shows the composition of this alloy, designated IN-102. Table 2 shows its comparative rupture strength at 1200 F in terms of several other alloys.

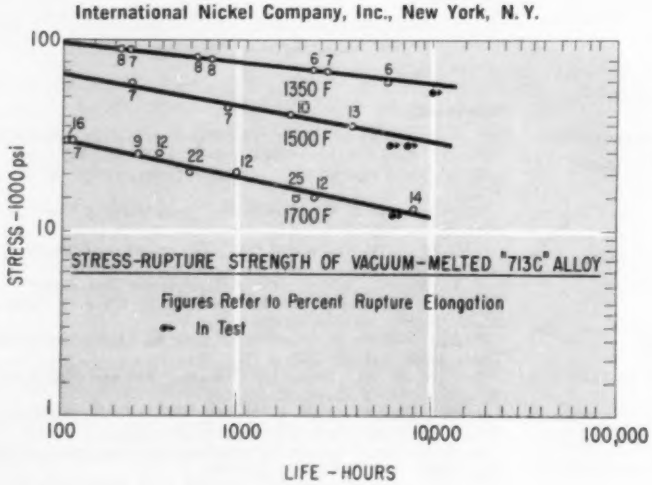
Long-time creep-rupture tests are in progress to get data for 10,000 hr or more. One test at 1200 F and 35,000 psi had not exceeded the second stage of creep after 6000 hr. Minimum creep rate at this time was about 0.1 per cent per 1000 hr.

Experience so far shows the material has good response to welding and brazing. Nippes hot-ductility tests indicate excellent ductility on both heating and cooling cycles. However, work is under way to strengthen the weld deposit with larger amounts of hardener, since welded joints with matched filler are only about 70 per cent efficient in the 1200 F rupture tests.

Inco developed this alloy for the steam turbine field, to be used in fairly heavy wall steam lines and superheater tubing. Another line of interest is in light wall-tubing for aircraft propulsion systems. Since it is essentially cobalt free, IN-102 may also offer a new material to the nuclear power field.

[1] Supervisor, High Nickel Alloys-Product Development, Inco Research Laboratory.

Condensed from a paper presented at the Inco Power Conference, sponsored by the International Nickel Company, Inc., with the cooperation of Denver Research Institute, University of Denver. Meeting held August 1-4, 1961, Estes Park, Colo.



STRESS-RUPTURE STRENGTH OF VACUUM-MELTED "713C" ALLOY

Figures Refer to Percent Rupture Elongation

•• In Test

TABLE 1

IN–102 EXPERIMENTAL ALLOY FOR LONG-TIME 1200°F APPLICATIONS

NOMINAL COMPOSITION

NICKEL	BALANCE
CHROMIUM	15
IRON	7
COLUMBIUM	3
MOLYBDENUM	3
TUNGSTEN	3
ALUMINUM	.5
TITANIUM	.5
CARBON	.06

Nickel-Chromium-Iron Base Alloy

Alloys with a nickel-chromium-iron base, such as Incoloy alloy, and Type 330 stainless, have been widely used where their strength, oxidation resistance, and relatively low price make them particularly attractive. There are, however, areas where somewhat stronger alloys of the same type are needed.

Table 3 shows the composition of two such alloys, with molybdenum and titanium added for more strength. The second and stronger of the two is further alloyed with two per cent columbium. Both the alloys are solid-solution strengthened, and a small aging increment is provided by one per cent titanium as well. Tests of several thousand hours with excellent retention of ductility indicate good structural stability.

1200 to 1400 F Range

A third alloy has been developed in the research laboratory for the 1200 to 1300 F range. Its manufacture utilizes solid-solution strengthening, accompanied by a substantial precipitation hardening. These processes are combined to retain the high tensile and rupture properties along with good ductility and virtual absence of the low-ductility trough. Such a combination of properties may make the alloy important to the gas turbine field. This composition is listed in Table 4.

The consistently high ductility, even at 1360 F, seems to provide more latitude for welding fabrication and postwelding heat-treatment than comparable age-hardened commercial alloy. Since the tests show the alloy to have a very high ductility at 1800 F, this suggests the alloy can be easily extruded and also hot-worked in large ingots.

Corrosion Resistant

There is a growing need for materials which are able to resist various hot corrosive environments. For example, the combustion of residual fuels containing vanadium pentoxide, sulfur, and salts can trigger severe corrosive attacks on metals.

Results have been encouraging with cast 60 Cr-40 Ni alloy when used in preheater tube supports. The Inco research laboratory is well along in the development of cast and wrought nickel-chromium alloys containing 30 to 60 per cent chromium. These alloys will provide the high resistance to corrosive environments shown by cast 60-40 alloy, but with better high-temperature properties so the alloy can have wider applications.

One goal is to get strength characteristics that would allow the material to be used for turbine blading in the industrial gas turbine. This way, the much cheaper residual fuels might be used while still attaining useful service life in the blade materials. Short-time tensile strengths at 1300 F in excess of 100,000 psi have been obtained on some of the alloys of the group under study.

Cast Rotor Wheels

Another project in the field of alloys is for an integrally cast rotor wheel. There are now alloys which do an excellent job in this field but are either not strong enough for the requirements of the immediate future, or must be melted and investment cast in a controlled atmosphere or vacuum. The present development is aimed at a material that can be melted and cast without special atmospheres. In formulating such an alloy, those elements known to be harmful to the alloy's castability are kept as low as possible. The desired strength is achieved through such elements as molybdenum and columbium.

This project is well along toward providing improved turbocharger-wheel alloys which call for a combination of 100,000-psi minimum yield strength, 10 per cent minimum elongation at room temperature, and 100-hr rupture strength at 1350 F and 60,000 psi. Preliminary attempts to produce wheel castings in the more promising compositions have been encouraging. Further work is under way to establish the proper composition and casting techniques more definitely. The next phase of the study will be directed toward extending the temperature capabilities of the material from 1500 to 1600 F for potential interest as a cast rotor wheel for automotive gas turbines. The development is not sufficiently advanced to provide details but it is reviewed here to indicate the current status of this casting alloy development.

Investment Cast Alloy

There is now more interest in long-time creep-rupture data on the new investment-cast alloy, designated 713-C. It has the nominal composition: 13 Cr, 4.5 Mo, 2 Cb, 6 Al, 0.6 Ti, 0.13 C, 0.01 B, 0.10 Zr, and the balance is Ni. Alloy 713-C was developed as a jet engine blade alloy for service around 1700 F. It exhibits excellent stability after long exposure at temperatures of 1350 to 1700 F.

Fig. 1 shows the long time rupture data at the present stage of the Inco research laboratory program. The long time data suggest 713-C may be useful in the industrial and automotive gas turbine fields. The results may suggest other applications where high rupture, creep strength, and good hot hardness are needed.

TABLE 2

ALLOY	APPROXIMATE 1200°F RUPTURE STRENGTH 10,000 HRS.	ESTIMATED 1200°F RUPTURE STRENGTH 100,000 HRS.
INCONEL ALLOY	12,000 PSI	10,000 PSI
INCONEL ALLOY 604	18,000	14,000
G 18 B, 15/15 N	28,000	17,000
N 155	24,000	17,000
IN – 102	40,000	28,000
TYPE 347	16,000	12,000
TYPE 316	17,000	12,000

TABLE 3

NOMINAL COMPOSITION OF TWO EXPERIMENTAL ALLOYS NI-CR-FE BASE

	(A)	(B)
NI	40	40
CR	15	15
FE	39	37
MO	5	5
CB	0	2
TI	1	1
C	.05	.05

A CALL FOR Standards

By R. C. Garretson,[1]
Westinghouse Electric Corporation,
Pittsburgh, Pa.

The over-all cost of lubrication is one important part of repair and maintenance costs in which great economies are possible. This cost includes:

1 The cost of the lubricants themselves.
2 The cost of application of lubricants.
3 The cost of power due to excessive friction.
4 The cost of repairs and replacements.
5 The cost of lost production due to repairs and replacements.

Since the development and universal acceptance of standards governing the application of hydraulics, electrics, and pneumatics have had a noticeable effect upon the costs of maintaining these components, the development of lubrication standards, such as those discussed in this paper, should have a similar effect upon lubrication costs.

Several years ago a lubrication engineer for one of the major automobile manufacturers presented a copy of the lubrication standards developed by his company. At Westinghouse, a meeting was called of representatives of our purchasing and plant-engineering departments, certain manufacturing engineers, and others, to discuss the need for lubrication standards for use by the East Pittsburgh Division. This group agreed that such standards could be of tremendous value to plant engineers, lubrication engineers, designers, machine-repair personnel, manufacturing personnel, and others, both in the design and in the selection of new equipment, whether for sale by or for use within the corporation.

Standards should in no way inhibit progress. They need not and should not be written as an inflexible code that must be adhered to regardless of cost or other considerations. They should know what should be done, rather than how it should be done. We intend to apply these requirements to all new or rebuilt standard or specially designed machine tools and other items of industrial equipment for use throughout the corporation.

[1] Plant Lubrication Engineer, East Pittsburgh Division.

Contributed by the Maintenance and Plant Engineering Division and presented at the Maintenance and Plant Engineering Conference, Worcester, Mass., April 10-11, 1961, of The American Society of Mechanical Engineers. Condensed from Paper No. 61—MPE-4.

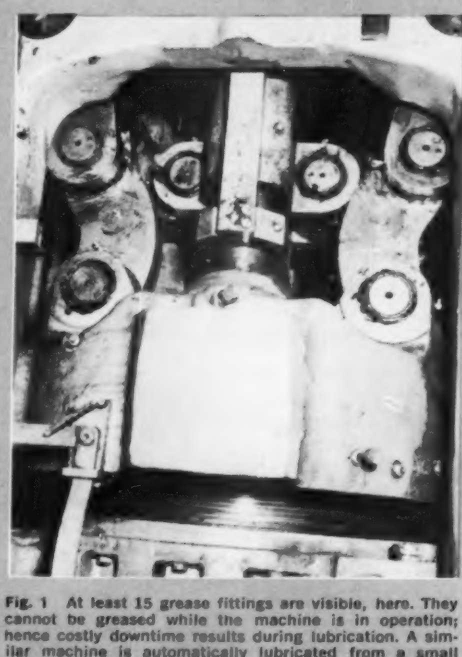
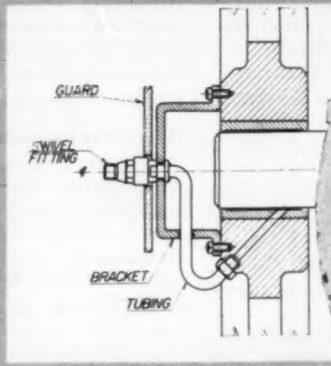


Fig. 1 At least 15 grease fittings are visible, here. They cannot be greased while the machine is in operation; hence costly downtime results during lubrication. A similar machine is automatically lubricated from a small pump.

The author makes a strong case for lubrication standards similar to the standards developed for hydraulics, electrics, and pneumatics. Improved lubrication design could markedly reduce maintenance costs.



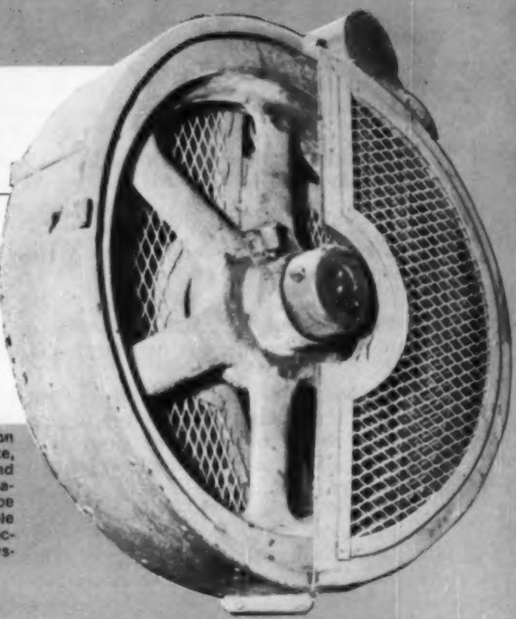


Fig. 2 A lub fitting mounted on the hub of a flywheel. To lubricate, the wheel must be stopped and the guard opened. Below is a diagram of how a fitting could be made that would be serviceable during operation — or for connection to a central lubrication system.

for Lubrication

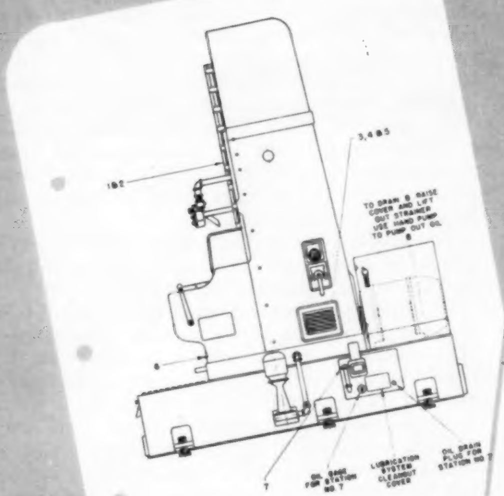
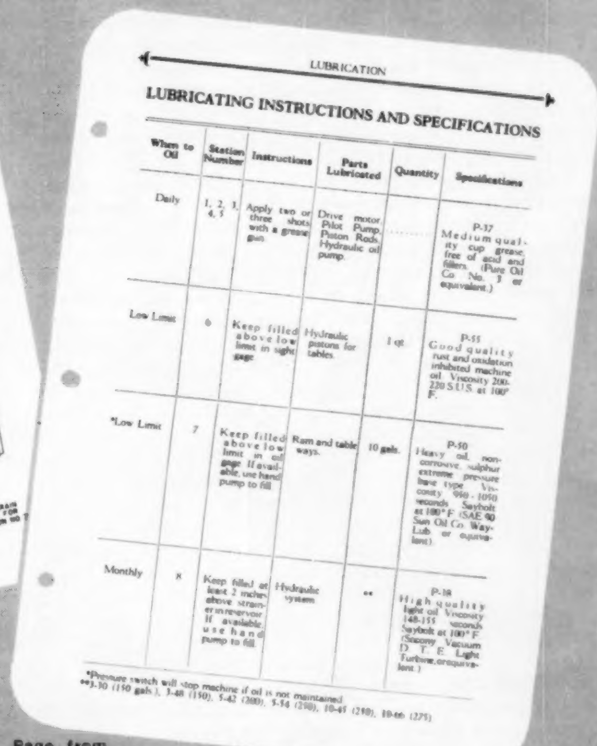


Fig. 3 How instructions should be given. This is a page from the operator's manual for a vertical broach. Every lubrication point is numbered, and an arrow points to its location on the diagram.



LUBRICATION

LUBRICATING INSTRUCTIONS AND SPECIFICATIONS

When to Oil	Station Number	Instructions	Parts Lubricated	Quantity	Specifications
Daily	1, 2, 3, 4, 5	Apply two or three shots with a grease gun.	Drive motor, Pilot Pump, Piston Rods, Hydraulic oil pump.	....	P-37 Medium quality cup grease, free of acid and fillers. (Pure Oil Co. No. 3 or equivalent.)
Low Limit	6	Keep filled above low limit in sight gage.	Hydraulic pistons for tables.	1 qt.	P-55 Good quality rust and oxidation inhibited machine oil. Viscosity 200-220 S.U.S. at 100° F.
*Low Limit	7	Keep filled above low limit in oil gage. If available, use hand pump to fill	Ram and table ways.	10 gals.	P-50 Heavy oil, non-corrosive, sulphur extreme pressure base type. Viscosity 900-1050 seconds Saybolt at 100° F (SAE 90 Sun Oil Co. Way-Lub or equivalent.)
Monthly	8	Keep filled at least 2 inches above strainer in reservoir. If available, use hand pump to fill.	Hydraulic system	**	P-18 High quality light oil. Viscosity 140-155 seconds Saybolt at 100° F (Socony Vacuum D. T. E. Light Turbine, or equivalent.)

*Pressure switch will stop machine if oil is not maintained

**3-30 (150 gals.), 3-48 (150), 5-42 (200), 5-54 (250), 10-45 (250), 10-66 (275)

Fig. 4 Page from the same manual. The chart lists each of the parts identified in Fig. 3 (both by number and part name).

What, Where, When?

It should not be too much to expect that manufacturers tell us exactly what type of lubricant to use, how often it should be applied, and how often it should be replaced. Yet it is not uncommon to read instructions as these:

"Lubricate top bearing each week." Shall we use oil or grease in this case?

"Change oil occasionally." Do they mean once a month, or only once every two years?

"Add the proper amount of grease." How much is the proper amount?

"Use premium quality SAE 20 oil." The SAE 20 tells us nothing about the quality or type of oil desired. Should it be a premium quality gear, hydraulic, or motor oil?

Oftentimes equipment builders list their own parts numbers for replacement filters, bearings, and so on. We will ask them to show the original manufacturer's number, to help us avoid duplication of identical parts which have different identification numbers.

All lubrication points shall be readily accessible without the necessity of removing guards, covers, and the like, and without the use of ladders. This point sounds reasonable, but there are many, many violations.

No grease fittings of the hydraulic type shall be used for the application of oil, unless they are somehow modified to prevent the use of a grease gun. There are several manufacturers who are guilty of violating this requirement, and we have experienced difficulty due to the use of grease where oil was specified.

Airline lubricators, if required, shall be supplied with the equipment and shall be provided with tamperproof, oil-feed adjustments to discourage unauthorized personnel from changing the rate of feed. The adjustment of such lubricators by the equipment operators often results in extreme "feast" or "famine" conditions.

If oil devices must be inaccessibly located, we shall require that they be provided with reservoirs large enough to hold at least a week's supply of oil. This requirement can save a lot of money in labor charges.

Centralized lubrication systems, preferably of the automatic type, shall be used whenever practical. Systems of this type permit the servicing of a great many bearings from one central location, again reducing the labor of application. This figure, incidentally, runs about $4.75 for every dollar's worth of lubricants we use, or about $135,000 per year.

Filters shall be installed so that they can be serviced while the equipment is in operation, if possible, and without draining the lubricant system and reservoir. One of our large, special-purpose machines has a filter below floor level. It is covered with a plate which is welded in place. This filter cannot be removed for repairs, nor is there enough room to remove the plug so that the filter sump can be drained of accumulated dirt. It will be a major job to service this filter some day.

Pumping units containing integral lubricant reservoirs shall be so located that the lubricant level can be determined easily and the reservoir filled from working level.

Reservoirs shall be designed and located so that they can be emptied and cleaned without spillage. The JIC Hydraulic Standards have been a help in this requirement, but many violations are still encountered. Some gear cases have no drains at all, and only very small openings for adding or pumping out the oil.

Oil reservoirs shall be provided with level indicators that show not only the high level when the equipment is stopped, but also the high and low running levels. According to instructions, some machines must be shut down for periods up to $^1/_2$ hr before checking the oil level. If these reservoirs are filled while the equipment is running, the oil will drain back and overflow when the equipment is stopped.

How to Buy Lubricants

We would prefer that lubricants recommended for use in industrial equipment be designated by specification numbers, or physical and chemical properties data. If this is not practical, then we believe that at least three brand names should be specified. There are several reasons for this, as follows:

1 The use of brand names leads to duplication of products.

2 The dangers of misapplication of lubricants will be reduced if a smaller number of lubricants is used.

3 Purchasing, handling, storing, and dispensing costs are reduced if fewer items are handled.

4 If only one brand is approved, a great deal of confusion will result if the supplier is unable to deliver, for one reason or another.

5 Quantity discounts often apply if larger volumes of fewer items are purchased.

6 The use of brand names can lead to unwarranted bias either for or against certain suppliers.

7 Since the formulation of brands may change at any time, without notice to the user, an oil recommended today may not be suitable for a given application at a later date.

8 Confusion results when equipment manufacturers continue to specify brands which were renamed, or perhaps even discontinued, at some earlier date.

The manufacturer of several of our special design machines approves only one brand for each point on his equipment. Therefore, under our setup of purchasing by specification or material numbers we are forced to buy, for example, two different slide-way lubricants. We purchase one by brand name for use in these machines only, and the other by specification. Actually, the specified brand is one of those approved against our material number. We have recently tried other approved brands in one of these machines, and so far they have been entirely satisfactory.

The accompanying illustrations (Figs. 1–9) show examples of both good and bad planning of lubrication equipment and lubrication instructions.

It is believed that the general acceptance of lubrication standards would be of tremendous importance to both the users and to the equipment builders. To the user it would mean lower costs of servicing equipment, and therefore higher profits. To the builder it would mean more satisfied customers, and lower costs due to the application of equipment on a production basis without the delay, expense, and confusion which inevitably result from attempts to follow special instructions.

Standards, Please

It is the author's personal hope that at some time in the near future a joint industry conference or perhaps some technical organization, such as the American Standards Association, the American Society of Lubrication Engineers, The American Society of Mechanical Engineers, or the National Machine Tool Builders Association will adopt a set of standards that would be acceptable throughout industry.

Fig. 5 Another good example: A metal tag attached adjacent to the point of lubrication, identifying correct lubricant by type.

Fig. 6 A number of grease fittings grouped together in one block, with copper tubes connecting each fitting to the bearing it services. This avoids shutdown, eliminates climbing, improves safety.

Fig. 7 Eliminating hand lubrication entirely. Either grease or oil can be forced from a reservoir through main lines to metering valves. The pump may service one or more machines.

Fig. 8 The right idea: But observe where the oil reservoir and pumping unit is placed. The machine has to be shut down, and the operator must use a table or ladder to fill the reservoir.

Fig. 9 Reservoirs should be designed, constructed, and located so as to prevent the entrance of solid or liquid contaminants. Here, every time the dipstick is removed to check oil level, dirt and metal chips may enter. A glass sight gage, and a screen in the fill pipe would prevent trouble.

Fig. 5

Fig. 6

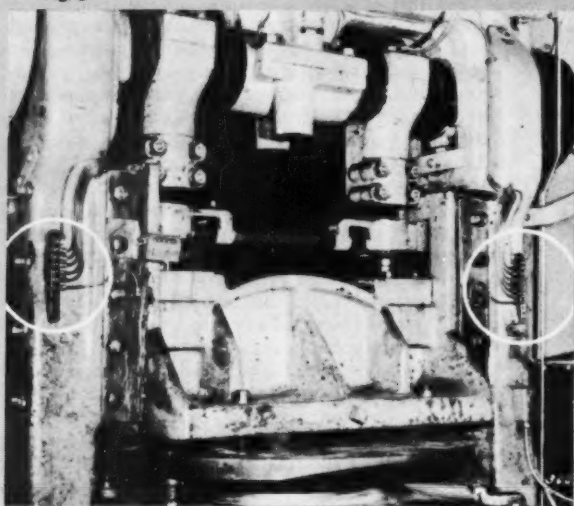
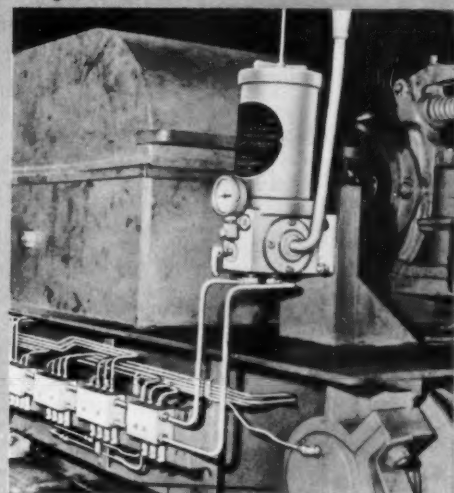


Fig. 7



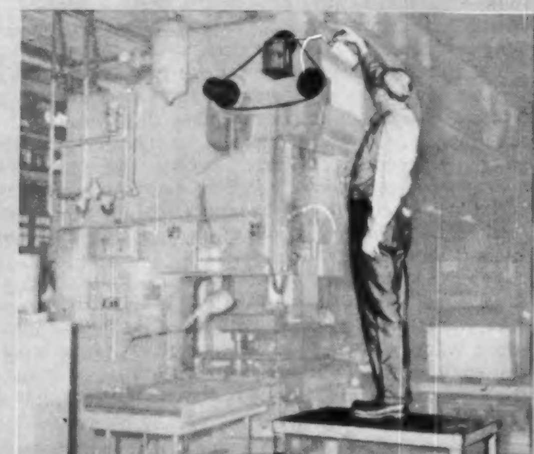


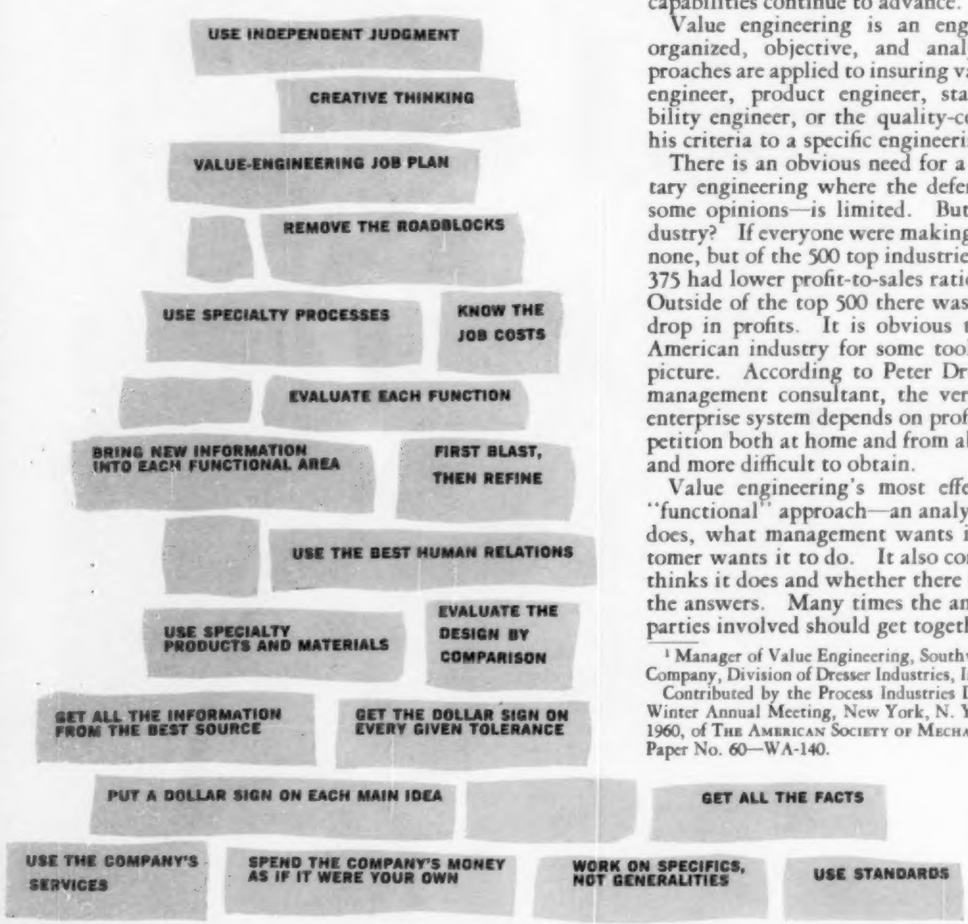
Fig. 8

Fig. 9

VALUE ENGINEERING

By Bernard William Eades, Jr.[1]

The economic squeeze is hard upon us, and one of the best antidotes is value engineering. This report is concerned with the why, what, when, and how of this new technique.



Value engineering or value analysis (the terms are usually synonymous) is a favorite discussion topic in industrial and military circles today, but feelings are mixed. Some like it and employ it while others feel that it is a temporary encroachment upon existing functions and will die out in a relatively short time. Others, like the author, see a definite need for such an endeavor and yet are conscious of its limitations.

Value is best defined as that optimum relationship of function, quality, and cost which combines in equipment the attributes of essential function, adequate dependability, and lowest total cost.

Function is defined in the value field as something which makes a product or a service work or sell, while essential function is a necessary use or service. Essential function could also be considered as any use characteristic necessary for equipment to fulfill the minimum requirements of the user.

Total cost is the sum of all costs for development, production, and use.

So far value, function, essential function, and total cost have been defined. To make the outline complete, a definition of value engineering is needed. The Electronics Industries Association's Value Engineering Committee accepts the following: "Value engineering systematically analyzes functions and costs to achieve essential function for the lowest total cost."

Value is ever changing and is determined by the technological and productive capabilities existing at the time of study. These capabilities are seldom improved by value engineering, but ways of utilizing the best of them are generally found. The need for value engineering is thus continual since the technological and productive capabilities continue to advance.

Value engineering is an engineering task wherein organized, objective, and analytical engineering approaches are applied to insuring value, much as the design engineer, product engineer, standards engineer, reliability engineer, or the quality-control engineer applies his criteria to a specific engineering task.

There is an obvious need for a value program in military engineering where the defense dollar—contrary to some opinions—is limited. But is there a need in industry? If everyone were making a profit there would be none, but of the 500 top industries in this country, about 375 had lower profit-to-sales ratios in 1959 than in 1958. Outside of the top 500 there was an average 15 per cent drop in profits. It is obvious that there is a need in American industry for some tool to improve the profit picture. According to Peter Drucker, the well-known management consultant, the very survival of our free-enterprise system depends on profits, and increasing competition both at home and from abroad makes them more and more difficult to obtain.

Value engineering's most effective approach is the "functional" approach—an analysis of what the product does, what management wants it to do, what the customer wants it to do. It also considers what each party thinks it does and whether there is a similarity in any of the answers. Many times the answers indicate that the parties involved should get together.

[1] Manager of Value Engineering, Southwestern Industrial Electronics Company, Division of Dresser Industries, Inc., Houston, Texas.

Contributed by the Process Industries Division and presented at the Winter Annual Meeting, New York, N. Y., November 27–December 2, 1960, of The American Society of Mechanical Engineers. Based on Paper No. 60—WA-140.

The possibilities of this line of approach are even more provocative when the question is asked: "What is the difference between a physical fact and a functional fact?" As an example, the military may establish a 500-mile radius as a requirement for a transmitter, bringing the cost to $5000. Actually, its function is to transmit within a radius of 300 miles, and a commercial transmitter with a 350-mile radius is available for $1000. Is it necessary to spend an extra $4000 for 150 miles of nonfunctional transmitter range when four additional transmitters could be purchased with the money that would be saved?

The Value-Engineering Approach

There are three basic philosophies in the dynamic approach to better value: (*a*) A better job can be done and everyone can do a better job—if the design material, methods, and vendor aren't the best; and if competitors are selling for less, a better job is needed and possible. (*b*) There should be no competition within the same company—teamlike effort is required of all persons involved with product design, production, and procurement. (*c*) We are all average people—there are no supermen, and human limitations must be accepted.

Several years ago a General Electric Company study revealed that over 80 per cent of the best accomplishments were realized where teamwork existed.

A value program has 20 techniques as its base, each of which is a subject in itself:

1 *Creative Thinking.* This is the method by which the greatest number of ideas is generated. From these ideas, the best lowest-cost method is selected.

2 *Value-Engineering Job Plan.* All jobs can be broken down into simple steps and any job is better carried out one step at a time with a planned program.

3 *Remove the Roadblocks.* Define the roadblock. Is it the system or the people that form the impediment? Isolate the roadblock, outline it sharply, and proceed systematically to eliminate it.

4 *Use Specialty Products and Materials.* Remember that each specialist is another arm for the company. He has worked long and hard to develop his specialty.

5 *Bring New Information Into Each Functional Area.* Use company specialists and outside specialists to apply new information to the problem.

6 *Use Specialty Processes.* Use specialty processes, if applicable, before your competitors.

7 *Know the Job Costs.* Know the shop costs (material, labor, and overhead) of every part and operation. Don't waste time working on equipment that already represents good value; there are too many fertile fields.

8 *Evaluate Each Function.* Divide the product into functional areas. Relate the cost of each area to the function it performs.

9 *Evaluate the Design by Comparison.* Value is determined by comparing one method of performing the function with another.

10 *Get All the Information From the Best Source.* The man who designed a product, or the man who knows the most about the job is the best source.

11 *Use the Best Human Relations.* Good human relations account for 90 per cent of the job; without them nothing will be accomplished.

12 *Get All the Facts.* A sound decision can't be made without all the facts, and a project shouldn't even be started until they are available.

13 *First Blast, Then Refine.* Rather than eliminate pennies from the cost of a design, try a completely new and different solution, and then modify it to meet the needs. This is the way the biggest savings are made.

14 *Get a Dollar Sign on Every Given Tolerance.* Find out what close tolerances cost.

15 *Use Independent Judgment.* If a job isn't right, do something about it. Use your own judgment and dig for the facts.

16 *Put a Dollar Sign on Each Main Idea.* Know how much your ideas are worth and don't try to evaluate them until you have knowledge of their cost.

17 *Spend the Company's Money as if It Were Your Own.* Nearly everything you do commits the company's money. Would you be willing to pay that much if it were your own money?

18 *Use the Company's Services.* Make the best use of the services which are available within the company.

19 *Work on Specifics, not Generalities.* Single out certain items and clean them up systematically one at a time.

20 *Use Standards.* Search diligently for a standard and wherever possible use standard parts.

These are the key techniques, the very soul of value engineering. Getting all the facts is one of the most difficult parts. The people who have custody of them hide them or lose them, either for convenience or self-preservation, and the value engineer must assay his information to see if he has all the facts or if his informant has misled him.

It is the functional approach—what is it? what does it do? how much does it cost? what else could do the same thing? how much would that cost?—that distinguishes value engineering from other forms of cost reduction. The first point to be investigated is to find out if a particular part or system is actually needed at all, rather than seeking first to reduce its cost.

Value-Engineering Job Plan

Value engineering has, in addition to its techniques, a definite method of procedure:

Information Phase. The first part of any program is a fact-finding stage, which quite often is three quarters of the job. Never go to the second phase of your study until you are satisfied that you have all the facts. Question the design engineer, the project engineer, and the specifications until you know the project thoroughly.

Speculation Phase. This is where creative ability is put to use. What else will do the job? The more ideas or solutions generated, the better the chance that one or more will be the answer to the problem. Use "brainstorm sessions."

Analytical Phase. After all the ideas have been assembled, it's time to analyze them and pass judgment on them. Remember, don't try to eliminate ideas but try to analyze them to see how they can be made to work. A positive approach must be used.

Program-Planning Phase. This is where the best ideas are selected and a program is planned to get the additional information needed to develop these ideas into sound usable suggestions. Search for the person or specialist who can help you. Draw in help from outside in the form of company venders or specialists.

Program-Execution Phase. This is where certain ideas really begin to develop and the planned program is followed up.

Summary and Conclusion. The final step, and one of the most important, is to do something with the facts.

VALUE ENGINEERING

Promote the ideas that have developed by presenting sound facts to those who can do something about them.

The Area of Endeavor

In addition to specific techniques, the work of the full-time professional value specialist falls into five major classifications—education, consultation, evaluation, integration, and implementation.

Education. The professional value specialist should teach both value techniques and value information. This involves both formal and informal training of management and line personnel to improve their "value-ability" and cost consciousness. Value information includes information on design, manufacturing, methods, processes, products, vendors, standards, and materials. The formal methods used to teach value techniques and value information are lectures, seminars, vendor seminars, task-force operations, displays, news sheets, published articles, brochures, and value proposals. The informal methods include personal contacts, group discussions, letters, and case histories.

Consultation. The value specialist must serve his company as a consultant and expert in the field of value, value techniques, and value information. Relieved of line responsibilities, he can keep abreast of new developments in materials, processes, machines, standards, vendors, methods, and products. He is a specialist in knowing where and how to go about getting specific information and bringing new knowledge into fundamental areas.

Evaluation. Evaluation is the way in which the value specialist can point the way to lower costs through the expert application of proved techniques in the evaluation of company products. Practical cost-reduction potentials are directed to those responsible for action by means of one-page factual proposals.

In doing evaluation work, the value specialist should never do anyone else's job. His is a service function designed to stimulate others by presenting factual suggestions for evaluation and decision to the responsible people in engineering, manufacturing, or purchasing. He should never do the engineer's job by involving himself with extensive testing, complex mathematical proofs, detailed design drafting, or other work the engineer must do to prove and describe a design. The value engineer or analyst does not parallel or duplicate the effort of any function, but supplements that effort in a way designed to strengthen each area he serves.

Integration. This element involves the establishment of correct relationships and practices with all business functions, managers, and personnel. It includes gaining support for the value activity and its extension into other functional areas as well as the provision of personnel motivation.

Implementation. There are instances where implementation is absolutely no problem. But, in other cases a proposed change runs head-long into "the way we have always done the job," and the decision has to be made whether to appease this segment of opinion or to insist on the objective. This is where the value specialist must have more than "lip service" from top management, either in the form of personal support or authority.

Location in the Organization

The location of the value group within an organizational structure is relatively unimportant. Value engineering will function no matter where it is placed. The principles are sound. The techniques have been proved. Just how well they will work will depend upon the person in charge.

If the value group is placed in purchasing, it becomes an after-the-fact or post-mortem enterprise. In some instances this is the best way for value engineering to operate, particularly if most of the components are purchased.

Where nearly all parts are manufactured and engineering changes are very infrequent, value engineering should probably be under manufacturing.

The value group could be under engineering. This would eliminate a great many engineering changes, particularly if the value engineering program operates concurrently with performance engineering.

Value engineering at the author's company is a separate entity and reports directly to the president. In this position it is free from domination by any single group. It is at present a service group and works with all line functions but comes under the direct influence of no one. This, in the author's opinion, is the best way for value engineering to work.

The objections to placing value engineering in this position can be vehement. An objective study, such as value engineering, uncovers all sorts of things and top management is acutely aware of this. Obviously, a great deal of care must be exercised in the human relations end of this program, but if the value engineering program is subservient, the personnel are apt to become obsequious, even pusillanimous.

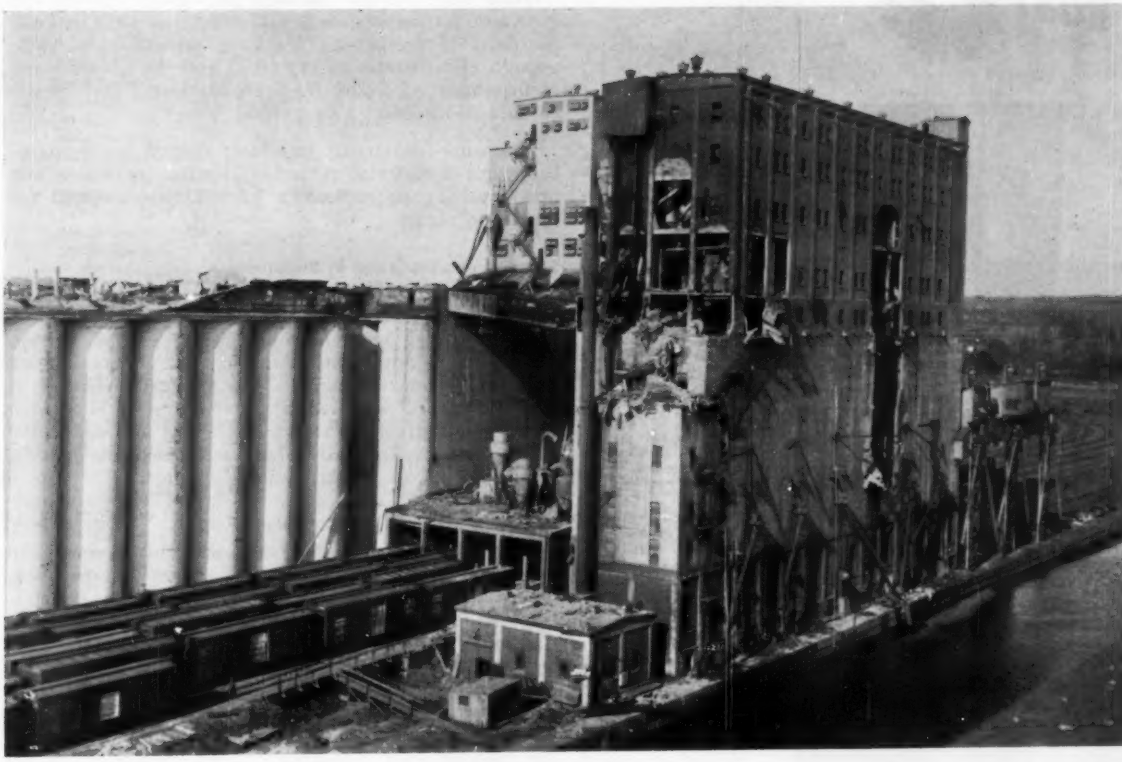
Wherever the organization is placed make sure that there is a strong nucleus and a strong second team. Sooner or later the group will become the victim of pirating, either from within or without.

On the matter of financing, the value-engineering effort will be charged either to direct or indirect labor or both. Some of the cost will probably go directly to the project and the rest to overhead.

Most departments of the military have a value-engineering specification similar to the Navy's Bu Ships Specification MIL-V-19858. Most of the specifications call for a split with the contractor of money saved where a specification cleavage is made. The split is usually 60-40, with the 60 per cent going to the military. However, the military usually pays the contractor for the study. Should you receive a military contract with a value engineering clause, get the specifics from those in the governing department. They are extremely cooperative and anxious to develop value engineering in their respective departments.

To summarize: Place your organization in a position where it will not be adversely influenced by line organizations. Staff it with the best personnel available and develop a strong nucleus. While this won't assure you of complete success, it definitely puts you on the right road.

When followed as outlined, your value program will yield at least 10 dollars for every dollar invested.



DUST EXPLOSIONS

Proper design of the plant, plus dust-control and explosion-control systems, will prevent or suppress explosion losses

By Robert W. Olson

Mill Mutual Fire Prevention Bureau, Chicago, Ill.

In any operation handling large quantities of wheat, coal, or similar bulk material, there are always large accumulations of dust. And always along with the dust is the awesome hazard—a dust explosion.

Any number of things can cause the spark that will make the dust-air mixture explode like a bomb, usually with the result of great material loss and sometimes loss of life.

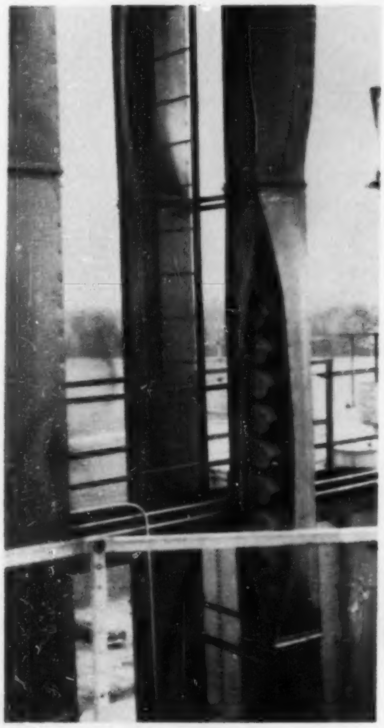
There are no foolproof systems that will insure complete explosion protection, but much can be done to minimize the possibility.

Most dust explosions originate in the bins and conveyer systems of the structure housing the bulk material. Before preventive steps can be taken, the causes must first be investigated. Table 1 shows some of the most common causes of these blasts. The information is the re-

Contributed by the Materials Handling Division and presented at the Bulk Solids Handling Symposium, Minneapolis, Minn., Oct. 17–19, 1961, of The American Society of Mechanical Engineers. Paper No. 61—BSH-1.

DUST EXPLOSIONS

Proper design of the plant, plus dust-control and explosion-control systems, will prevent or suppress explosion losses



Carelessness caused this conveyer leg explosion. Someone started the conveyer while the duct was being welded. When the grain dust hit the hot metal, the explosion traveled through the duct and blasted it open in several places. Employee carelessness accounts for a large percentage of all dust explosions. An adequate safety program, strictly enforced, can keep explosion hazards to a minimum.

sult of the survey of the major dust explosions which occurred between 1860 through 1956.

By far the greatest number of explosions have occurred in the collector or bin of the dust-collecting system. Foreign material, usually made up of matches, cigarettes, nails, and other flammable or sparking material, is the second greatest hazard. Hot bearings, and belt and pulley friction hold the second and third position in causes for explosion in conveying systems.

Unknown causes and welding are in fifth position. Welding ranks high because of the increased amount of welding done in plants along with the increased use of metal bins and conveying equipment. These explosions are usually caused by welders who have no knowledge of the danger of dust explosions. Many cases have resulted in serious injury or death to the welder.

Misaligned elevator belts with metallic buckets striking the sides of the elevator leg have also caused several incidents.

Although static sparking has been investigated by many agencies, it remains somewhat of an unknown explosion cause. Here are some of the proposed causes:

A human body may carry as much as 10 millijoules of energy [1][1] which is enough charge to set off an explosion.

Grain passing through a cloud of dust in a bin is believed to create enough friction to generate an electrostatic charge that may cause an explosion.

Grain dusts moving through pneumatic systems can generate charges up to 30,000 volts. If sufficient capacitance is present and leakage resistance is high, enough electrostatic energy (0.33 joule by lab tests and approximately 2 joules by practical tests) may be accumulated to ignite a dust cloud.

Extension-cord lights smashing against bin walls or being left in material in the bin, elevator leg chokes, and fires resulting in explosions have each accounted for several incidents.

Retarding an Explosion by Suppression

Once an explosion has begun, it is difficult to stop. But, through the use of quick-action electric sensing devices coupled with high-pressure sprinklers or suppression exploding bombs, the explosion may be suppressed in some instances. The explosion hazard is greatly reduced when such systems are coupled with rotary gate valves to isolate machinery and conveying systems. By venting all isolated sections to the outside, the hazard is reduced still more.

Proper Design Prevents Explosion

Proper designing of bins and conveying systems can keep an explosion from starting in some instances and reduce the explosion effects in others. A system's original design must consider the dust which will be encountered and its physical and chemical characteristics throughout the entire plant. Once the characteristics have been analyzed, the areas of maximum hazard should be found.

Keep in mind the fact that an explosion will follow the path of least resistance. Cases are known where explosions have communicated through galleys with relatively little damage and completely exploded another section of the building.

Preventing an explosion from communicating is the first step in correct construction design. If an explosion does occur, the building will be subjected to pressures which reach a maximum of 120 psi and have a maximum rate of pressure rise of over 10,000 psi per sec [3].

Isolate as many sections of the building and equipment as possible. Use self-closing fire doors, rotary gate valves, vent openings with explosion choke doors, and unconnected bins. Build as many areas as possible out of light construction material such as corrugated metal wall, pop-out window, and diaphragms. After the expolsion areas have been correctly identified and isolated, consider the location of machinery, conveying systems, and bins within the building proper. Design each bin with effective venting for the explosion pressure of the material it will handle. If possible, locate bins, conveying systems, and machinery within buildings as close to the walls as possible so that the venting distance will not be far. Excessive venting lengths in explosions cause a delay in relief time due to friction, inertia of the gases within the venting duct, and the rate of rise of pressure of the explosion. The shape of the vent is usually not important with relationship to the effectiveness of venting the explosion. However, when a diaphragm is used over the vent, rectangular vents are found to be slightly more effective in quick pressure relief than circular or square vents because of higher stresses at the mid-points of the diaphragm sides. Diaphragm material

[1] Numbers in brackets indicate References at end of paper.

Causes of Important Dust Explosions From 1860 Through 1956

CAUSE	Coal		Feed Cereal		Flour		Grain		Metal		Starch & Corn		Sulfur		Wood		Misc.[1]		TOTAL	
	B	CS	B	CS	B	CS	B	CS	B	CS	B	CS	B	CS	B	CS	B	CS	B	CS
Fire	1	•	•	•	1	•	•	2	•	•	•	•	•	•	•	•	4	•	6	2
Spontaneous	1	1	•	•	2	•	1	•	•	•	•	•	•	•	•	•	•	•	4	1
Unknown	•	1	1	1	2	•	3	2	•	•	•	•	1	1	•	•	1	•	8	5
Welding	1	2	•	1	•	•	•	3	1	3	•	•	•	•	•	•	1	1	3	10
Dust Collection	•	2	•	3	3	•	•	•	•	•	1	•	•	•	3	2	4	8	11	15
Foreign Material	•	•	•	5	•	3	1	2	•	•	•	4	1	1	1	•	•	3	3	18
Hot Bearing	•	•	•	2	•	6	•	4	•	1	•	2	•	•	•	1	•	1	•	17
Sparks—Elevator Bucket	•	•	•	•	•	•	•	3	•	•	•	•	•	3	•	1	•	3	•	10
Extension Cord Light	•	•	1	•	4	•	1	•	•	•	1	•	•	•	•	•	1	•	8	•
Friction—Belt & Pulley	•	•	•	1	•	3	•	7	•	•	•	•	•	•	•	2	•	3	•	16
Static Spark	•	•	•	•	•	•	4	3	•	1	•	•	•	•	•	1	•	•	4	5
Elevator Leg Choke	•	•	•	•	•	•	•	7	•	•	•	1	•	•	•	•	•	•	•	8
TOTAL	3	6	2	12	13	12	10	33	1	5	2	7	2	5	4	7	11	19	47	107

B—Explosion in Bin
CS—Explosion in Conveying System Excluding Processing Machinery

[1]Miscellaneous includes: Bark, Cork, Cotton, Fertilizer, Paper, Plastic, Rubber, Seed and Sugar

should have a low burst strength [4]. The vent ratios (vent area in sq ft per 100 cu ft of volume) for some common materials are:

Type of dust	Vent ratio sq ft/cu ft
Cocoa	4.8
Sugar	6.8
Wood flour	5.6
Soy bean protein	8.5
Coal dust	6.2
Grain	8.5
Cork	9.5
Cellulose acetate	9.7
Corn starch	13.3

The listed vent ratios are the areas needed to hold pressure to a maximum of 2 lb per sq in. [5]. If free-swinging panels are used, the weight of the panel should be kept to a minimum because of the inertia forces.

As another explosion preventative, inert gas may be applied to conveying systems, machinery, and bins to reduce the oxygen content. The amount of inert gas to use with each dust material will vary. The minimum oxygen contents that will prevent ignition by electric spark are:

Type of dust	Per cent oxygen
Electrolitic iron	13
Stamped magnesium	15
Zinc	10
Cellulose acetate	11
Shellac	14
Corn starch	10
Soy bean	15
Wood flour	17

Much experimental work has been done in this field and many other values are available.

A pneumatic system within a plant is a probable reduction of hazard because it has a small number of moving parts. Inert gas in the system will reduce the fire hazard, and the turbulent action of the air is considered too great for explosive propagation of flame in many cases.

Plant Maintenance

Beware of any outside factors that will cause or lead to conditions that will result in an explosion within bins and conveying systems. Keep the plant as dust free as possible by maintaining adequate dust-collection systems, dust-tight equipment, and always sweeping clean.

Another hazard, tramp iron, can be removed from the flow of material by magnetic separators. Several explosions have been caused by ferrous material entering machinery or sparking against the walls of bins.

Keep all moving parts properly oiled to prevent excessive wear and overheating. Maintain all electrical equipment in a dust-free and clean condition. Properly sized fuses and overload relays are also prime requirements. By constant vigilance, electrical equipment will be no hazard.

Welding on a conveying system which is in operation is very dangerous. When it is impossible to weld in any other place but the work area, stop all equipment in the area where the welding is being done. Lock the machinery in the stop position and clean dust from the machinery and welding. Many men have been injured by someone starting a piece of conveying equipment when metal was still hot or being welded.

Employee Education

The largest percentage of the explosion hazards may be eliminated by properly educating the employee to the dangers of a dust explosion and the means to prevent it. Such things as dropping an electric light into a bin to determine the level of material it contains, welding, and careless smoking are all human factors which have caused inexcusable loss. A plant will be much safer if everyday safety practices are aggressively driven home.

References

1 I. Hartman, "Recent Research on the Explosibility of Dust Dispersions," *Industrial and Engineering Chemistry*, vol. 40, 1948, p. 752.

2 A. R. Morse, "A Study of the September 1952 Dust Explosion at Port Arthur, Canada, Grain Elevator No. 4A," National Research Council of Canada, Ottawa, Canada, NRC No. 3614, 1955, pp. 150, 137, and 138.

3 T. Baumeister, "Mechanical Engineering Handbook," McGraw-Hill Book Company, Inc., New York, N. Y., 1958, pp. 7, 44–45.

4 John Nagy, "Pressure Relieving Capacities of Diaphragms and Other Devices for Venting Dust Explosions," U. S. Bureau of Mines, Pittsburgh, Pa., RI 4636, 1950, p. 12.

5 I. Hartman and J. Nagy, "Venting Dust Explosions," *Industrial and Engineering Chemistry*, vol. 49, 1957, p. 1737.

Other References

Dr. George A. Hulett, "Explosibility of Grain Dusts," Millers Committee of Buffalo, New York, U. S. Bureau of Mines, Pittsburgh, Pa., 1914, p. 25.

"Explosion Suppression and Protection," Graviner Manufacturing Company, Ltd., London, England, 1953, p. 4.

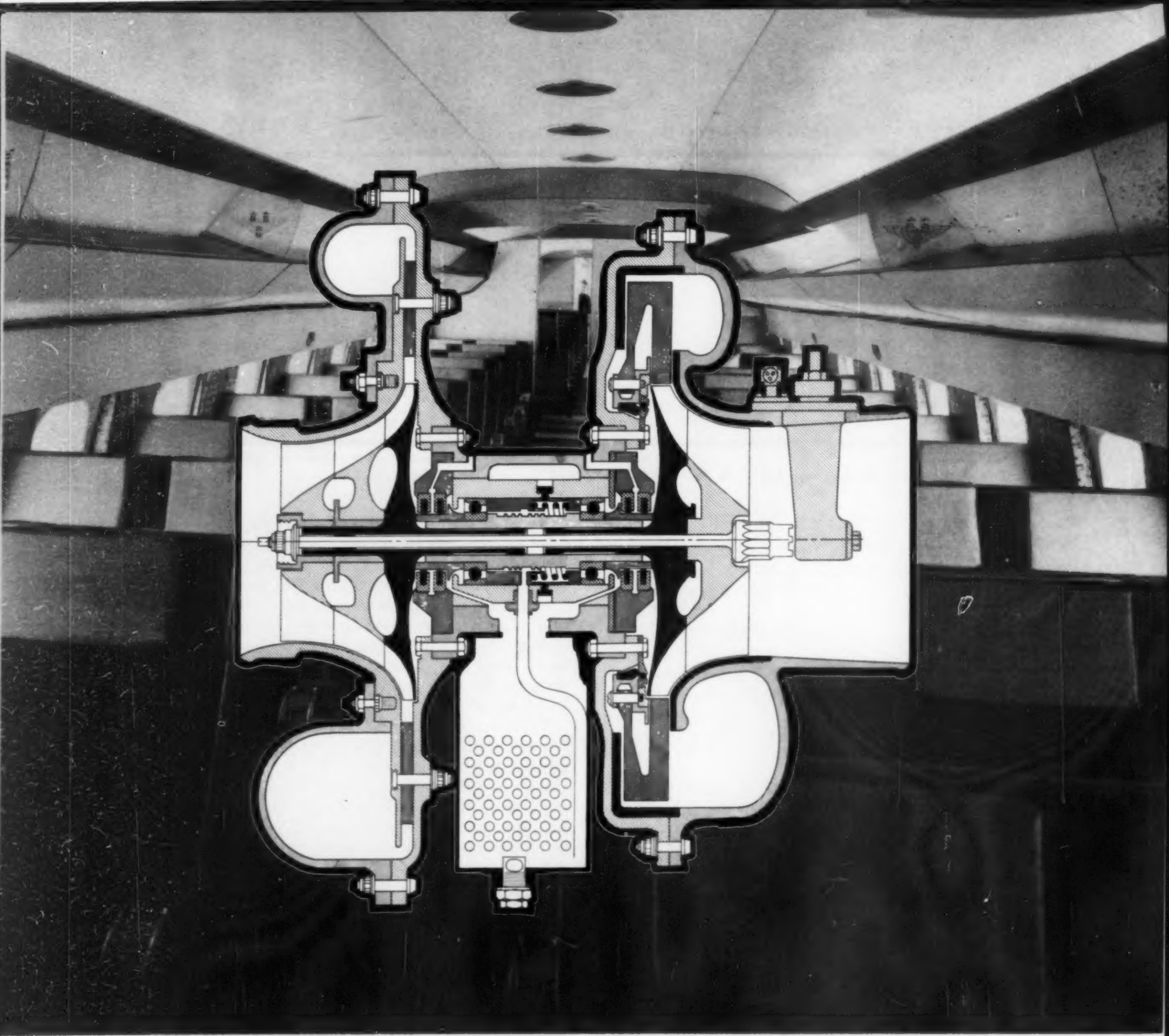


Fig. 1 Semischematic of the turbocompressor

The supercharged air you breathe in the cabin of a jet airliner comes from turbocompressors driven by high-pressure air bled from the

AIR FOR THE JET'S CABIN

main engines. Here's the story of their development.

By W. W. Thayer
Douglas Aircraft Company, Inc., Santa Monica, Calif.

PRESENT-DAY turbojet and turbofan transports have nearly twice the ceiling of their piston-powered predecessors and require greater pressure-ratio capability and superior reliability in their cabin-pressurization systems. Turbocompressors have been used universally in these systems for the first generation of American commercial turbojet transports because of uncertainty that direct engine bleed air would be pure enough to suit the traveling public. On the DC-8, four of these high-speed centrifugal compressors, driven by variable-nozzle, radial turbines, provide cabin pressurization and heating. Pneumatic driving power is bled from the airplane's main engines.

The turbocompressor, Figs. 1 and 2, comprises a single-stage centrifugal compressor, directly driven by a single-stage radial-inflow turbine and automatically controlled to provide the desired compressor air-flow rate. Compressor ram-air intake is from the nose of the airplane, for maximum air purity. Compressor discharge pressure is determined by independent pressurization and heating-control systems. These are not part of the turbocompressor.

The turbocompressor weighs 90 lb and, at standard sea-level conditions, delivers 60 lb per min of air. Impellers are approximately $7^3/_8$ in. in diam. Normal speed ranges from 13,000 to 45,000 rpm, and turbine output ranges from 10 to 90 hp. The maximum bleed-air temperature and pressure limits of the power supply are 38 psig and 450 F, at steady state. These limits are provided by independent controls to suit an extensive pneumatic system of which the turbocompressor is a part. Much lower values are encountered during some modes of engine operation. Nearly maximum power output may be required when only 13 psig is available. Conversely, minimum power output may be required when maximum pressure is available.

Douglas Aircraft Company, Inc., has long been active in cabin-compressor development [1, 2].[1] Pioneering efforts began in 1937 and since that time Douglas hydromechanically driven cabin-compressor designs have accumulated over 25,000,000 flight hr.

[1] Numbers in brackets indicate References at end of paper.

Contributed by the Aviation Division and presented at the Aviation Conference, Los Angeles, Calif., March 12–16, 1961, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from Paper No. 61—Av-11.

The engineering challenges that existed at the start of this turbocompressor development were:

1 *Aerodynamics.* To nearly double the flight-altitude capability of prior cabin compressors, yet maintain the simplicity of single-stage design. (Only a few jet-engine-size compressors had previously achieved such performance; these had much more favorable Reynolds numbers and impeller blades proportionally half as thick.)

2 *Strength.* To be positive of complete safety, despite high tip speed.

3 *Controls.* To provide autonomy, reliability, and design simplicity, even though this required development of relatively unconventional pneumatic elements.

4 *Machine Design.* To guarantee a 2000-hr overhaul period with a machine utilizing antifriction bearings at DN = 1,000,000, when the operating limit for comparable military turbomachinery was about 500 hr.[2]

5 *Compatibility.* To integrate the turbocompressor into the heating and cooling systems of the airplane in the best possible way.

Aerodynamics

Compressor Design. How these requirements were harmonized is shown with reference to the compressor performance map, Fig. 3. Point A, the high-altitude, maximum-pressure-ratio point, was determined by the airplane requirements. The compressor was then designed to have a minimum tip speed at this condition by locating its stall line as close to Point A as practical, based on anticipated transient performance of the control system. This determined one of the most crucial numbers, namely, the tip speed for failed-rotor containment demonstration. Time schedules required many expensive developmental activities to continue concurrently, thus inability to produce this projected performance would have been a calamity. The effects of variations in Reynolds number were included by controlling the inlet temperature and pressure to correspond to actual airplane flight conditions. The unit was carefully insulated to obtain accurate adiabatic efficiencies.

The simplest possible flow-control concept was chosen, namely, ρv^2 control (to be described later). As altitude is reduced from the maximum, such a control traces the

[2] D = inner-ring bore diam, millimeters; N = rpm.

Fig. 2 The turbocompressor

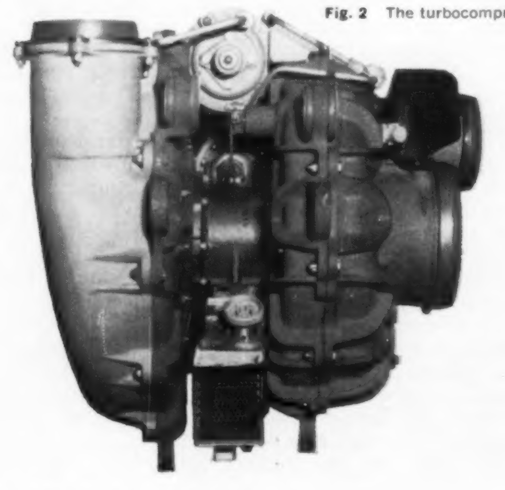
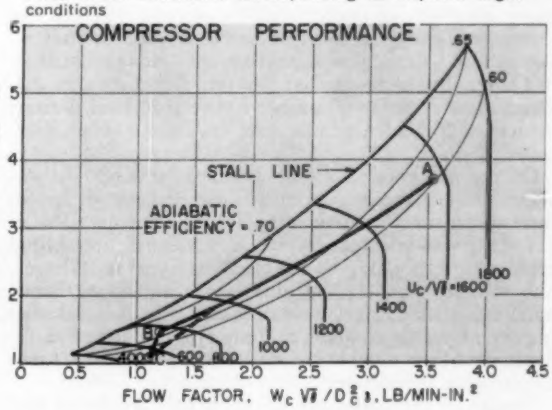


Fig. 3 Compressor performance demonstrated in laboratory tests under conditions corresponding to airplane flight conditions



AIR FOR THE JET'S CABIN

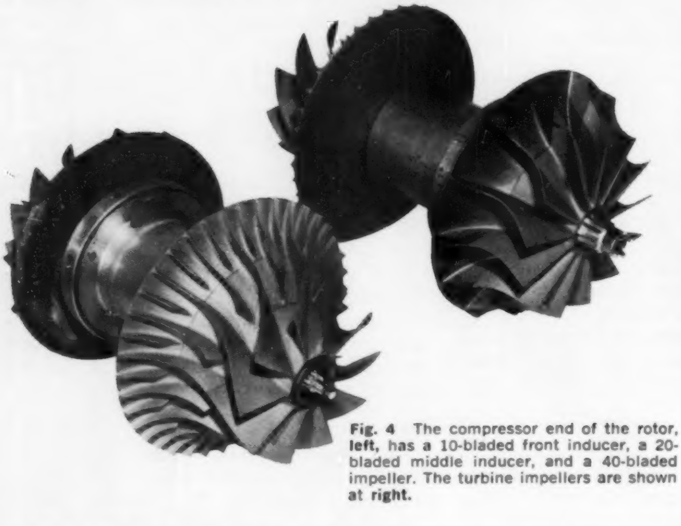


Fig. 4 The compressor end of the rotor, **left**, has a 10-bladed front inducer, a 20-bladed middle inducer, and a 40-bladed impeller. The turbine impellers are shown at **right**.

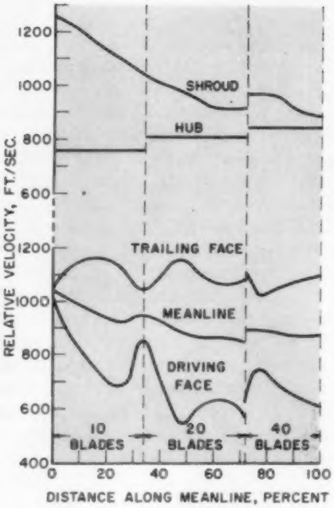


Fig. 5 Calculated relative velocities for the compressor impeller

path A-B in Fig. 3, where B is the maximum pressure ratio that can be developed at sea level, for use with either a heating or a cooling system. (Point C indicates the operating point at sea-level ventilating conditions.)

Point B provides a compression ratio that is adequate for cabin-heating requirements. However, to get the higher pressure ratio needed for an adequate air-cycle cooling system would have required adding undesirable control complication. Such complexity was unnecessary in this case because an independent, vapor-cycle cooling system was preferred for the airplane.

A centrifugal configuration with a nearly radial discharge was chosen to minimize weight and axial length. The impeller design was determined by a chain of related limitations: (*a*) All the bladed elements must be completely machined from forgings for maximum reliability; (*b*) because tooling to machine such curved bladed shapes has a long procurement time, it was necessary to determine the required shapes early in the program, thus limiting design activity to analytical procedures rather than experimental methods; (*c*) reasonable cutter size required that no more than 10 blades be used at the inducer inlet. Since one of the fundamental goals in the compressor design was to minimize tip speed, that is, have a low "slip," it was obvious that many more than 10 blades should be used at the impeller discharge [3]. Therefore a decision was made to use a 10-bladed front inducer, a 20-bladed middle inducer, and a 40-bladed impeller, Fig. 4.

Of the many publications available to assist in impeller design, ranging from one-dimensional to quasi-three-dimensional treatments [4–10], that detailed in Ref. [10] was selected. Velocity gradients and shroud profiles corresponding to arbitrarily selected hub shapes, hub velocity profiles, and blade curvatures were refined until acceptable values were obtained, Fig. 5. Another important factor in inducer design is the inlet-eye inducer-tip Mach number; a maximum value of 1.07 was employed in this design.

Design of the collecting scroll, based largely on Ref. [11], was not considered critical enough to require provisions for design flexibility. Since the diffuser involved the possibility of much higher losses, vane shape and orientation were varied experimentally until late in the program. The design, which could be put into production quickly, consisted of 17 separate, airfoil-shaped vanes, having a high enough thickness-to-chord ratio to accept through bolts. The vanes were contour-milled from steel and nickel-plated all over for erosion and corrosion protection. This construction provided great strength for the containment of failed rotors, by providing a close-in tie between front and rear housings, and by inserting effective choppers in the path of any fragments. The integration of fail-safe and performance features such as this was one of the main concepts in the turbocompressor design.

Turbine Design. Essential information on available bleed-air pressure and temperature is often extremely fluid in the early days of a new airplane design. To design the turbine for too low a bleed pressure in descent penalizes performance at cruise, whereas to choose too high a pressure risks restricting engine operation. A compromise choice of 13 psig as the minimum design pressure was arbitrarily made. This turned out to be an excellent decision.

Turbine-impeller size and proportions were determined by relying on Refs. [12 and 13] and on unpublished data from tests in which an earlier cabin compressor was operated as a turbine. (Several other publications are now available [14–17].) In addition, the design methods of Ref. [10] used for the compressor were also used to determine blade curvatures and hub and shroud shapes corresponding to desirable velocity gradients.

Variable-area nozzles were chosen as the turbine-control means to minimize power loss. The configuration selected provides a small and constant nozzle-to-impeller clearance independent of nozzle position, and controls the flow direction so that it becomes more tangential as nozzle area is descreased.

The unit was thoroughly insulated so laboratory

TERMINOLOGY USED IN FIGS. 6–9, TURBINE PERFORMANCE CURVES

Definitions

Flow factor = $W\sqrt{\theta}/D^2\delta$, lb per min-in.^{2}
Power factor = $HP/D^2\delta\sqrt{\theta}$, hp/in.^{2}
Speed factor = $U/\sqrt{\theta}$, fps

Nomenclature

A_N = nozzle flow area, in.^{2}
D = major diameter of appropriate rotor, in.
hp = horsepower
P = total pressure, in. Hg abs
p = static pressure, in. Hg abs
U = peripheral velocity of rotor blades at major diameter, fps
W = flow rate, lb per sec
δ = ratio of inlet total pressure to NASA standard sea-level pressure (29.92 in. Hg abs)
θ = ratio of inlet total temperature to NASA standard sea-level temperature (518.4 R)

Subscripts

1 = measured in duct upstream of turbo
2 = measured in duct downstream of turbo
C = compressor
T = turbine

temperature measurements could be used to compute power output. Since a variable parameter (nozzle area) is involved, a family of maps, Figs. 6–9, is needed to make a performance presentation, in contrast to the single map needed for a fixed-component compressor. "Speed factor" is held constant on each map, and "power factor" is plotted versus "flow factor," with nozzle area and pressure ratio as parameters (see definitions). This presentation is a departure from prior practice [12] and is intended to facilitate certain commonly encountered computations.

Strength

The fundamental strength-analysis concepts applied to the turbocompressor rotor disks were: (*a*) To design their profiles for minimum disk bending, and (*b*) to keep the inertia stresses at a level estimated to be low enough to provide satisfactory fatigue life. This level was chosen as two thirds of the yield strength of the material at maximum rated speed. Initial rough hand-calculated rotor-disk contours were refined by an iterative process on high-speed computing machines. Temperatures were low enough to permit the use of 2014-T61 aluminum alloy throughout the compressor and for the turbine exducer. Annealed titanium alloy (6 per cent aluminum, 4 per cent vanadium) was used for the turbine impeller. A sample of each rotor element was whirled in an evacuated spin-pit, constructed specifically for this purpose, until either a burst was achieved or at least 100,000 rpm had been reached. All elements reached at least 80,000 rpm and the turbine impeller reached 105,000 rpm. Stresscoat tests determined the strain patterns (indicated stress levels) and located regions of stress concentrations.

Turbine and compressor impellers were designed to incorporate integral shafts, Fig. 2. This eliminated any possibility of impeller-to-shaft looseness, which risks destructive vibration, and proved to be successful.

The containment problem was reduced to coping with a random failure within the normal speed range by rely-

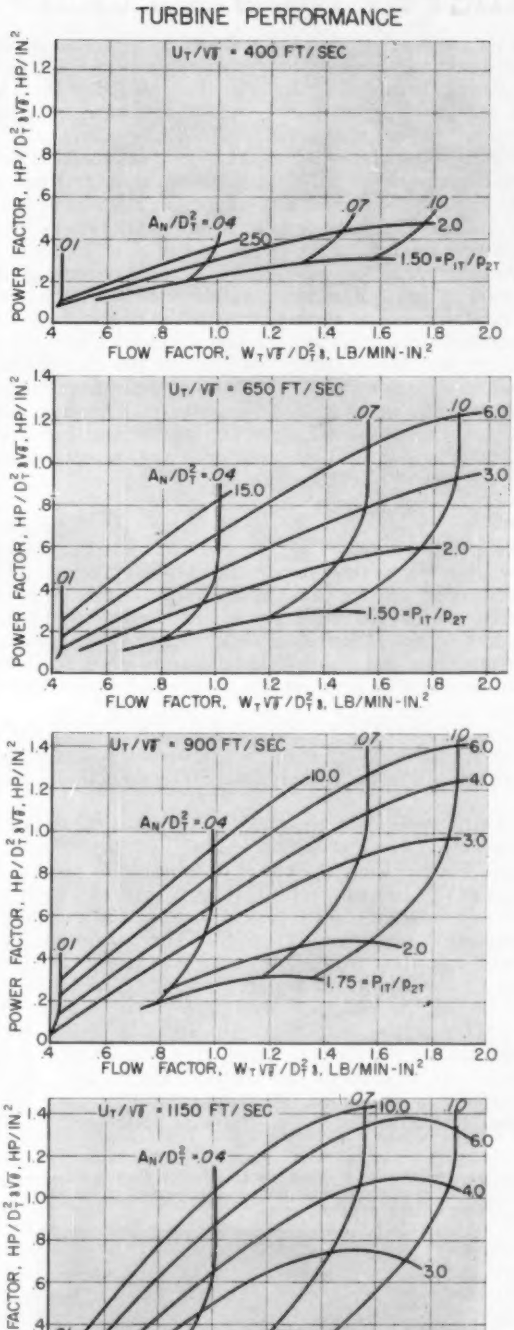


Fig. 6-9 Turbine performance at peripheral velocities of the rotor blades ranging from 400 to 1150 fps

ing on a primary electrical overspeed device set at 50,000 rpm, backed by a secondary mechanical overspeed device set 10 per cent higher. Even at this speed, the stress is less than half of that which the weakest element withstood in spin-pit tests.

Failed-rotor containment of the final configuration was demonstrated, Fig. 10, by running separate destructive tests on both the turbine and compressor. Failures were induced to occur almost exactly at 50,000 rpm by progressively weakening the rotors.

Another phase of strength verification concerned vibration testing. Resonance was detected with windows in the inlet shroud through which the edges of the inducer and exducer blades could be viewed. Under black light, a thin line of irridescent paint on the edge of each blade in a plane normal to the axis of rotation produced narrow light streaks when the rotor was running normally. At resonance, these streaks became bands of appreciable width, because the curved blades would vibrate normal to themselves.

Controls

Design Requirements. The control system was the biggest problem. To achieve maximum simplicity, it had been necessary to venture into the field of low-pressure pneumatics which has been given little treatment in the modern technical literature. Both high-speed computing machines and a full-scale laboratory pneumatic system were used in development, followed by considerable flight testing.

Error is sensed as a departure from a prescribed static-pressure difference existing between two points in the compressor flow path where different cross-sectional areas exist.

In this application the maximum permissible negative (low-flow) error was determined by the compressor stall line. For efficiency reasons it is desirable to operate as close to this line as practical, that is, there is a trade-off possible between control-system performance and turbo-compressor operating efficiency. The maximum permissible positive (high-flow) error was set by the closeness of the maximum required operating speed to the setting of the electrical overspeed device. Since the overspeed setting determined the speed at which burst containment was demonstrated, this was another tight limit. At sea level or low altitude, less accuracy in the control was demanded, the applicable high-flow limit being determined by noise, drafts on passengers, and on

Fig. 10 Ability to contain a failed rotor. Failure was induced at 50,000 rpm by progressively weakening the rotor with a series of drilled holes.

hot days by heat input, which increases rapidly with flow rate.

The control could not oscillate for prolonged periods even within the prescribed maximum and minimum permissible errors, as annoying sound would be produced and objectionable wear would be anticipated.

All of the foregoing requirements had to be met with all four turbocompressors operating in parallel, subject to the following possible disturbances:

1 Rapid change of compressor-discharge pressure due to manually positioning the various throttle valves in the compressor-discharge path, or cyclic change due to automatic operation of the cabin-heating or pressurizing-system controls.

2 Cyclic change in compressor-inlet pressure due to ram-scoop instability. (More details will follow.)

3 Rapid change in turbine-inlet pressure caused by manual movement of the engine power lever, or by automatic switchover at the engine bleed ports from high pressure to low pressure, and vice versa.

4 Rapid change in turbine-inlet pressure and compressor-outlet pressure during the cabin-compressor starting transient.

5 Cyclic changes in turbine-inlet pressure caused by operation of the cyclic deicing system from a pneumatic supply manifold common to the turbocompressors.

System Description. In the control system that evolved from these requirements, Fig. 11, error is sensed by a primary diaphragm and rate-of-change of error by the larger "rate" diaphragm. At a low-flow condition, for example, the forces developed by these diaphragms overbalance the spring force and move the control-valve poppet toward the closed position. This added restriction in the path of a small pneumatic bleed flow out of the head end of the actuator builds up the pressure there and moves the nozzles in the direction to increase compressor flow. There is only one feature of the control system that is not readily obvious from the schematic diagram, and that is the purpose of the 17 "piccolo holes" distributed along the actuator rod. They compensate for aerodynamic forces on the turbine nozzles to insure a positive slope of the actuator load-stroke curve. Pressure is maintained in the rod end of the actuator by restricting a small pneumatic bleed flow out of it, this restriction being varied as a function of actuator stroke by the number of piccolo holes that remain inside the actuator as the rod extends.

This system was originally developed using a slide valve and an actuator with sliding seals. Major improvements in reliability were achieved (*a*) by changing to a poppet-type valve, Fig. 12, in which the poppet is completely supported by diaphragms, thus eliminating friction and dirt-sensitivity; and (*b*) by changing to an actuator, Fig. 13, which employs long-stroke, rolling diaphragms and axial ball bushings, thus eliminating seal-leakage and friction problems.

Space does not permit discussing more than one example of the many challenging problems that were solved in this control-system development. It was found that this nonlinear control system had a distinctive limit cycle at a frequency of 2.3 cps and that something occasionally excited it. After weeks of investigation this excitation was found to be a 7-cps aerodynamic pressure ripple of small magnitude in the compressor ram-air inlet, thus illustrating an interesting example of subharmonic response. The pressure ripple was readily removed by

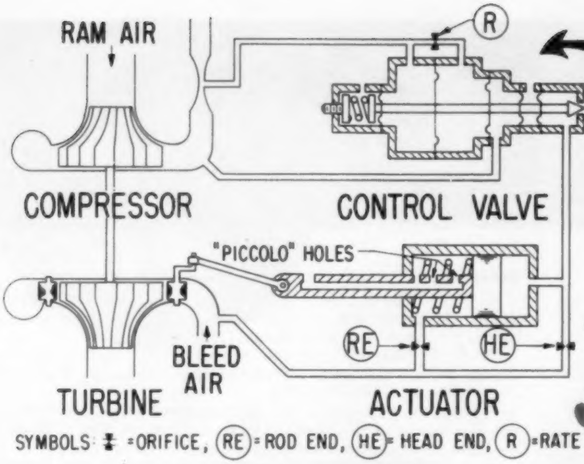


Fig. 11 Schematic of the control system

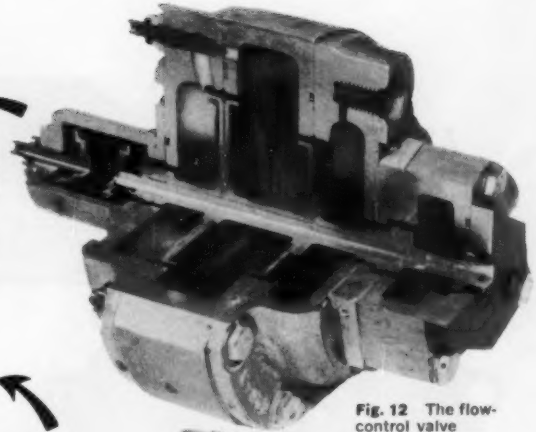


Fig. 12 The flow-control valve


Fig. 13 The nozzle actuator

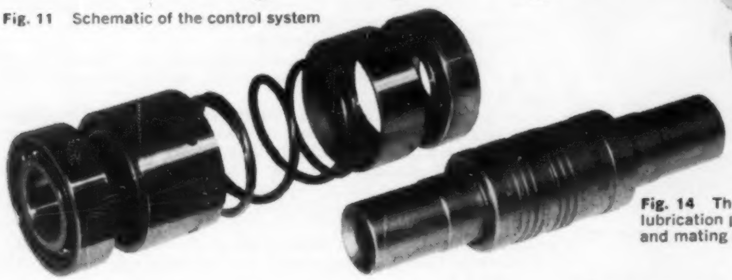


Fig. 14 The lubrication pump and mating parts

increasing the minimum flow through a heat exchanger which used the same airscoop.

Machine Design

Miscellaneous Features. Simplicity dominated the requirements for the mechanical aspects of the turbocompressor. A mechanically complicated, two-stage compressor was eliminated by developing the necessary capability in a single compressor stage. The need for oil under pressure was eliminated by the adoption of pneumatic controls, as already mentioned, and antifriction bearings, to be discussed later. This eliminated pressure pumps, gears, pressure regulators, external oil coolers, and their accompanying problems.

A bearing oiling system, totally devoid of wear-particle generators, was provided by using a threaded main shaft, shown in Fig. 14, running inside a suitable housing [18]. Heat rejection with such a lubrication system and antifriction bearings was low enough to be handled by a small cooler integral with the oil sump.

Since the primary reason for using a turbocompressor was to insure a supply of clean air, a two-stage seal with an amply vented region between stages was provided for both the compressor and turbine. These seals are capable of preventing oil from entering the compressor air even under such abnormal operating conditions as a partially blocked compressor inlet or a failed turbine seal. In addition, they minimize oil depletion by reducing the blow-off of oil fumes through the sump vent.

One of the most interesting mechanical aspects of the turbocompressor design was the provision of variable-area nozzles [19], Fig. 15. Principal problems overcome in the development of this design concerned control of friction and control of bypass air leakage. The nozzles are investment-cast stainless steel, having excellent erosion resistance, and providing a major portion of the failed-rotor containment capability of the turbine.

Bearing Package. Although previous cabin-compressor designs [1, 2] had successfully used journal bearings on the high-speed shaft for millions of hours, antifriction bearings were chosen for simplification of design. Of the many designs tested [20–22], the configuration shown in Fig. 2 was chosen. Two 25-mm angular-contact ball bearings, besides providing a maximum ball complement, permit the use of one-piece ball separators.

Radial bearing loads are limited by dynamically balancing the rotating assembly within 0.003 in-oz in the plane of each bearing. External thrust load was measured under actual operating conditions in the laboratory, and found to reach a maximum of 40 lb, directed toward the turbine. This load is taken on the cooler-running compressor bearing. It is in addition to the 65-lb spring load which was chosen after calculations[3] and tests with ten times the normal out-of-balance. These indicated that a "quasicritical" speed, that is, one dependent primarily on ball looseness rather than shaft bending, was encountered when half as strong a spring was used.

Selection of the amount of oil to be supplied to the bearings was guided by Refs. [23 and 24], plus other factors, such as staying safely below an oil-foaming limit and providing sufficient oil for turbocompressor starts after cold-soaking at high altitude. The severe cold-starting-ability requirement eliminated many of the bearing configurations. Turbojet engine oil, MIL-L-7808, used elsewhere on the airplane, was found to be a suitable lubricant. Care was taken in the lubrication-system design to trap some residual oil in the bearing upon shutdown, to assist the next start.

[3] Calculations were made by Thomas Barish, Consultant, Cleveland, Ohio.

AIR FOR THE JET'S CABIN

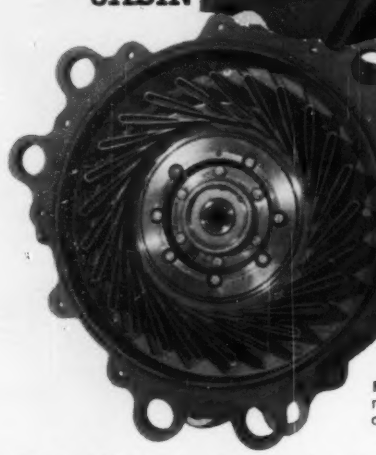


Fig. 15 Variable-area nozzles of investment-cast stainless steel

Overhaul Limit. After 2000 hr of service life there was no indication that the bearings were close to a fatigue limit. Some separator wear was evident which might become the life-limiting factor in the future.

The first 12 turbocompressors to reach 350 hr in service were removed for inspection. Thereafter, the Federal Aviation Agency-approved operating-time limit was extended in increments of about 350 hr until, at the end of only one year of service, the original target of a 2000-hr operating-time limit was attained. Further extension of the time will logically proceed on an economic basis.

Future Outlook

In the five years spanned by this paper, engine manufacturers have made real progress in the direction of insuring uncontaminated bleed air for air-conditioning purposes. If cabin-air turbocompressors are utilized in airplanes of the future, it will probably be because their design provides significant operating economies through the saving of bleed air and drag. Furthermore, such pressure-transforming turbocompressors, unlike the engines, will be controlled to produce pressures no higher than required for air-conditioning purposes, and will thus reduce costs involved in cooling-system capacity and/or operation. Turbocompressors may also enhance airframe-design flexibility by permitting relatively easy adaptation to advanced power plants, particularly when they are installed outside of the engine section. The fact that a 2000-hr operating-time limit has been readily achieved with the current design speaks highly for the basic simplicity of this type of equipment. Future machines, if any, should start with at least this degree of reliability and should have encouraging aerodynamic-efficiency growth prospects.

Acknowledgment

The DC-8 turbocompressor development was a team effort within the Douglas Aircraft Company, Inc., Santa Monica, Calif. Key engineers were J. L. Weisel, M. J. Hamilton, L. Gray, J. R. Withee, R. E. Luoto, and R. T. Carter. The turbocompressor was part of an extensive air-conditioning pneumatic system that was engineered under the general direction of W. W. Reaser, Mem. ASME.

References

1 W. W. Thayer, "Some Applications of Hydraulics to High-Speed Rotary Drives for Aircraft Accessories," SAE National Aeronautic Meeting (Spring), New York, April 11, 1947.

2 W. W. Thayer, "Hydraulic Aspects of the Douglas Cabin Supercharger Drive," Transport Aircraft Hydraulic Conference, Vickers, Inc., Detroit, Mich., November, 1954.

3 Masaaki Shirakura, "An Approximate Method of Determining the Slip Factor on the Radial Outward-Flow Impellers," *Bulletin of the Japan Society of Mechanical Engineers*, vol. 1, April, 1958, pp. 171–178.

4 J. D. Stanitz, "Some Theoretical Aerodynamic Investigations of Impellers in Radial and Mixed-Flow Centrifugal Compressors," *Trans. ASME*, vol. 74, May, 1952, pp. 473–497.

5 L. R. Wosika, "Radial-Flow Compressors and Turbines for the Simple, Small Gas Turbine," *Trans. ASME*, vol. 74, November, 1952, pp. 1337–1347.

6 Ivan E. Speer, "Design and Development of a Broad-Range High-Efficiency Centrifugal Compressor for a Small Gas-Turbine Compressor Unit," *Trans. ASME*, vol. 75, April, 1953, pp. 395–407.

7 James J. Kramer, Walter M. Osborn, and Joseph T. Hamrick, "Design and Test of Mixed-Flow and Centrifugal Impellers," *Trans. ASME—Journal of Engineering for Power*, vol. 82, Ser. A, April, 1960, pp. 127–135.

8 Irving A. Johnsen and Ambrose Ginsburg, "Some NACA Research on Centrifugal Impellers," *Trans. ASME*, vol. 75, July, 1953, pp. 805–817.

9 J. E. Coppage, F. Dallenbach, H. P. Eichenberger, G. E. Hlavaka, E. M. Knoernschild, and N. Van Le, "Study of Supersonic Radial Compressors for Refrigeration and Pressurization Systems," WADC TR 55-257, ASTIA AD 110467, December, 1956.

10 K. J. Smith and J. T. Hamrick, "A Rapid, Approximate Method for the Design of Hub-Shroud Profiles of Centrifugal Impellers of Given Blade Shape," NACA TN 3399, March, 1955.

11 W. B. Brown and G. R. Bradshaw, "Design and Performance of Family of Diffusing Scrolls With Mixed-Flow Impeller and Vaneless Diffuser," NACA Report 936, 1949.

12 Homer J. Wood, "Characteristics of Expansion Turbines for Auxiliary Power," *Trans. SAE* vol. 6, July, 1952, pp. 438–449.

13 O. E. Balje, "A Contribution to the Problem of Designing Radial Turbomachines," *Trans. ASME*, vol. 74, May, 1952, pp. 451–472.

14 E. M. Knoernschild, "The Radial Turbine, for Low Specific Speeds and Low-Velocity Factors," *Trans. ASME—Journal of Engineering for Power*, vol. 83, Ser. A, January, 1961, pp. 1–8.

15 Rudolph Birmann, "The Elastic-Fluid Centripetal Turbine for High-Speed Outputs," *Trans. ASME*, vol. 76, February, 1954, pp. 173–187.

16 Richard L. Robinson, "Some Theoretical Aspects of Centripetal Turbines," ASME Paper No. 53—S-38.

17 Ichiro Watanabe and Toru Ando, "Experimental Study on Radial Turbine, With Special Reference to the Influence of the Number of Impeller Blades on Performance Characteristics," *Bulletin of the Japan Society of Mechanical Engineers*, vol. 2, August, 1959, pp. 457–462.

18 R. A. Strub, "Spindle Drag Pump," *Machine Design*, vol. 25, July, 1953, pp. 149–151.

19 W. T. von der Nuell, "Single-Stage Radial Turbines for Gaseous Substances With High Rotative and Low Specific Speed," *Trans. ASME*, vol. 74, May, 1952, pp. 499–515.

20 L. W. McKee, "Ultra High Speed Bearings—Their Selection and Application," *Missile Design and Development*, vol. 6, August, 1960, pp. 18–23.

21 Heinz Hanau, "Ball Bearings for High Speeds and High Temperatures," *Machine Design*, vol. 29, November 15, 1956, pp. 88–106.

22 A. B. Jones, "The Life of High-Speed Ball Bearings," *Trans. ASME*, vol. 74, July, 1952, pp. 695–703.

23 G. Getzlaff, "The Behavior of Rolling Bearings at Very High Running Speeds," *The Engineers Digest*, vol. 13, November, 1952, pp. 379–384.

24 C. C. Moore and F. C. Jones, "Operating Characteristics of High-Speed Ball Bearings at High Oil-Flow Rates," *Trans. ASME*, vol. 78, July, 1956, pp. 997–1002.

Abstracts and Comments Based on Current Periodicals and Events

ROBERT ARONSON
Editorial Asst.

BRIEFING THE RECORD

The **top** tank has been stretched about 13 per cent by the Ardeform process. **Bottom** tank is the unstretched preform. By stretching at cryogenic temperatures the nominal tensile strength has been increased by about 138,000 psi.

Cryogenic Stretch Forming

Arde-Portland has a cryogenic metalworking process that literally inflates a metal vessel to its proper size. Essentially, it is a cryogenic stretch-forming operation. Liquid nitrogen chills an undersized vessel to around −320 F. Then, by forcing gaseous nitrogen into the vessel, it expands to its new shape.

The process has far fewer steps than any alternative metalworking process involving heat-treating. Consequently, it is less expensive. And, as another big advantage, cold working at cryogenic temperatures improves the room temperature strength of austenitic stainless steels to a great extent.

The first step in this process, called Ardeform, is the making of an undersized vessel called the preform. This vessel is the same size and shape as the desired end product, only smaller. In the case of a cylindrical vessel, the center section comes from annealed sheet stock. The heads are hydroformed, then annealed, and bosses are attached to the head. Arde-Portland has an automatic, seam tracking welding unit to join all the parts. The welds must be good quality since there is a sizable amount of stretching. However, an inexpensive roll and weld technique can be used.

The completed preform goes inside a stainless-steel forming die. The die is simply a rolled and welded cylinder, the size of the finished product. The preform, after being anchored in the die, is placed into the forming tank. Because of the danger of explosion, the operation is carried out in a pit covered with a blast mat.

In the stretching operation, liquid nitrogen fills the forming tank, including the preform. When the preform is chilled to the temperature of the nitrogen, the operator sends gaseous nitrogen into the preform. The nitrogen expands the preform like a metal balloon until it reaches the walls of the surrounding die.

After stretching, the preform goes back to the shop for final machining.

The illustration shows the arrangement of the preform, die, and forming tank. The pit in the illustration is only a pilot setup. Production facilities will have pumps to remove the nitrogen to a storage area; now the nitrogen is lost.

To date, vessels fabricated from 301 stainless steel have been stretched about 13 per cent in diameter to give ultimate tensile strengths of 260,000 psi. In the manufacture of cases for solid-propellant rocket engines, the ultimate tensile strength has been increased from the current 200,000 to 220,000 psi, up to 260,000 psi. This should lead to a weight saving of 1000 lb in an ICBM, which can then be converted to more payload and greater range.

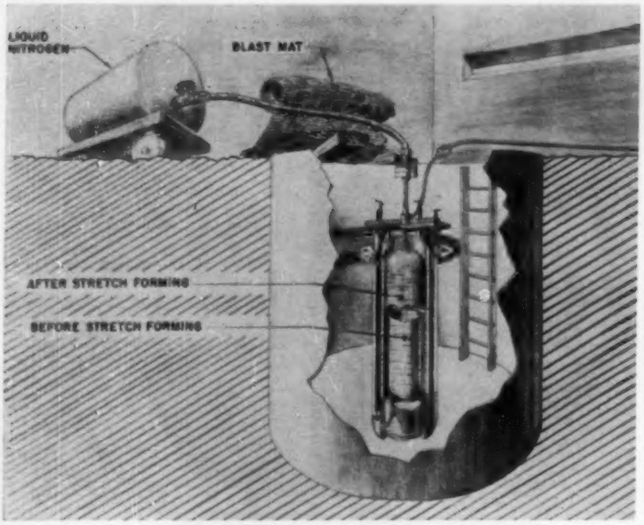
Some of the units produced by the Ardeform process have achieved nominal tensile strengths of 285,000 psi—equivalent to a strength-to-weight ratio of more than one million in. Ben Aleck, Arde-Portland research director and ASME member who developed the process, says nominal tensile strengths should reach 400,000 psi and strength-to-weight ratios of 1.4 million in.

Most of the vessels made in the pilot operation were constructed of AISI 301 stainless steel. The company has done some work with AISI 302 and 304 as well as with aluminum and titanium. The process should also work to a greater or lesser degree with all other austenitic stainless steels.

Aside from the missile applications, the process will probably be used in the fabrication of thin-walled pressure vessels, mobile storage containers, and high-strength tubing.

Additional Advantages. Since the vessel is formed before it is worked, the welds, as well as the base metal, are strengthened.

Forming pit holds die and preform submerged in liquid nitrogen. From the control room, gaseous nitrogen is forced into the preform until the preform expands to fit the shape of the die.



There is no limit to the size of vessel that can be fabricated. On the other hand, the largest solid-propellant rocket cast that can be handled in currently available heat-treating furnaces is about 12 ft in diam.

There need be no attempt to control out-of-roundness, straightness, or diameter during welding. All dents and distortions are removed during stretching. Welds are made without fixtures and weld shrinkage can occur without restraint. The result is a crack-free weld with a minimum of residual stresses.

There is no close dimensional control. The preform needs no internal machining and needs less stock removal during final machining.

The stretching operation doubles as a proof test for the vessel.

Process Drawbacks. In some cases Ardeform needs more care in the design of the basic vessel than standard metalworking processes. For example, to get a finished pressure vessel with spherical heads, the preform heads must be judiciously designed with regard to material and thickness to be sure dimensions are those desired.

Dummy heads are needed to make a simple open cylinder. It is first necessary to turn the preform into a closed vessel that can be pressurized and stretched. Presently this requires two expendable heads and two extra welding and cutting operations. Offsetting this is the fact that the total cost of an Ardeform cylinder—including allowances for the extra steps involving the heads—is less than that of a comparable cylinder fabricated by standard heat-treating methods.

Putting attachments on an Ardeform vessel sometimes requires more care than conventional metalworking processes. Because the preforms must come out fully to the die, certain types of attachments cannot be welded on until after the vessel is stretched and in the strengthened condition. Heat generated by the welding weakens the vessel locally. To counteract this, they return the vessel to the forming pit where it is restretched cryogenically without the die. This brings the strength of the weld area up to that of the rest of the case.

Russian Research

Most of us don't know too much about the background of the Russian space effort or just how their research program functions. Here is one description by Professor Hannes Alfven, head of the Electronics Institute of the Royal Swedish Institute of Technology. In our continuing struggle with Russia, it's sometimes interesting to get the opinion of a "third party."

"It is obvious that space research in the Soviet Union has entailed very high expenses, but we do not know exactly how high. A comparison with U. S. expenses, which at present are between one and two billion dollars per year, may give some idea, but one cannot take it for granted that the Soviet Union's costs have been higher than those of the United States. The Russian triumph originates, I think, mainly in the fact that for some time their work has been systematically concentrated on the realization of space flights and the fact that they have managed to organize an extremely qualified team which has been working devoutly on this project over a long period of time.

"Even if the costs for a ticket to space are enormously high compared to the sums usually spent on scientific research, they are very low as seen from the national economy viewpoint. The guesses that have been made about the Russian costs never come as high as one per cent of the national income. It is nonsense to suggest, therefore, that the Russian standard of living is being kept down in order to finance space research. The expenses in connection with space research in the Soviet Union constitute only a fraction of the amounts used there for military purposes. Per capita, the expenses are probably less than we (the Swedes) spend in this country on liquor or tobacco or advertising. I do not think the Russian refrains from drinking and smoking because of space research, but the amount he saves by not having commercial advertising probably goes a long way to finance this particular space flight as well as all future ones. Compared with the giant resources now available to mankind, a trip out in space, from the financial standpoint, is like a picnic.

"The organization of scientific research in the Soviet Union is probably superior to that in most other countries, and as many of the main features of this organization could very well be carried out under nondictatorial and noncommunist conditions, we have every reason to study it carefully.

"The Soviet Union's scientific and technical development is led by Akademia Nauk. The literal translation is 'Science Academy' but it carries very little resemblance to our science academy. Akademia Nauk is not under any department but on the same level or, in certain respects, even more influential than the departments. In this Academy, the country's most prominent scientists can draw up long-range programs for scientific and technical development, and these programs are not automatically referred to the wastepaper basket—which happens in many other countries—and the Academy also has the possibility of fulfilling them. It is likely that many mistakes have been made—some have been given much publicity in the West, others I guess we will never know about—but the main impression is, nevertheless, that the leaders (of the Academy) have been very competent and industrious. The Academy was probably greatly influential in creating the very excellent organization of education, particularly higher education, and it probably has had effective support in the fact that the love of stud-

ies and intellectual training is as great as it appears, judging from many testimonies. To what extent the academy has led the military-technical development is a military secret. One thing is certain, however, and that is the fact that the Soviet space research is the result of several decades' work which has been purposefully aimed at making it possible to go out in space. A long-range program of this type, which does not aim directly at military or economic advantages, would be possible only if a group of scientists with their imagination centered on long-range goals were given the degree of freedom of action they seem to have in the Soviet Union."

Monomer-Cast Nylon

A NEW nylon casting process from the Polymer Corporation for the first time permits low-cost production of large, complex nylon parts. The process gives engineers a new material for large bushings, cams, rollers, and contour wear parts.

This monomer casting process (MC) is a direct conversion of nylon from basic chemical raw materials to finished parts or shapes; casting and polymerization take place simultaneously. The material that results from this process, MC nylon, is a Type 6 formulation.

Until now, the advantages of nylon could not be used in large parts because of the high tooling costs and the process limitations of conventional molding methods. In monomer casting of MC nylon, direct production of the finished nylon parts from monomer, rather than powders of nylon polymer, cuts raw material costs. Unlike other nylon coversion methods, monomer casting is performed at atmospheric pressure. There is no need for the expensive molds required in conventional injection or extrusion molding of nylon polymers. However, MC nylon does not harden in the mold fast enough to compete with injection molding, a process now widely used for mass production of small parts.

The general production procedures used in monomer casting are similar to those used in casting metals. However, careful chemical controls are required in monomer casting. The purity and temperatures of materials and molds must be closely controlled for this process.

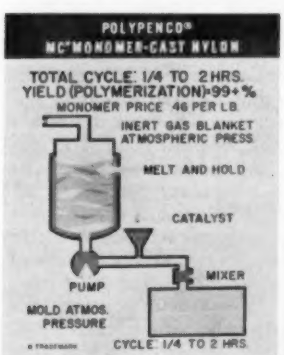
The Monsanto Chemical Company discovered the basic chemistry involved in monomer casting. Now, the Polymer Corporation has the exclusive right to use the process in the field of casting nylon shapes in the United States and many other countries. The technology for making MC nylon has developed from laboratory scale to commercial production.

Castings made from MC nylon, which now costs between $3.00 and $5.00 per lb, are substantially lower in cost, on a per-piece basis, than stainless steel or brass casting and compete favorably with alloy steels. In the next several years increasing volume and production economies will probably reduce the costs to about 50 per cent of the present level, bringing MC nylon on a competitive par with carbon steel and aluminum castings.

The largest MC nylon parts produced so far have been semifinished symmetrical shapes in the 500 to 700-lb range. A steel casting the same size would weigh over two tons. Theoretically, there is no limit to the size part that can be made by the process.

Potential markets include castings for metalworking equipment, railway equipment, paper-making machinery, and others. In these jobs, nylon's lightweight, toughness, and wear resistance without lubrication give a better performance at lower cost.

MC nylon is now commercially available in stock shapes, such as tubular bar, in lengths up to 4 ft, and in plate up to 4 in. thick, in 4-ft by 4-ft sections. Larger shapes are in limited production.



The total cycle for producing monomer cast nylon is quite simple. Molding is done at atmospheric pressure. MC takes from 15 min to 2 hr on the average cycle while other multistep processes run from 19 to 44 hr. Many large shapes can now be cast that were formerly impractical.

The pinch pulse plasma engine will probably be used to steer spaceships and control reconnaissance and communications satellites. It is now being tested at Republic Aviation's laboratories.

Pinch Pulse Plasma Engine

THE state of matter known as plasma is being successfully applied to a propulsion engine by Republic Aviation Corporation. This engine is said to be capable of operating indefinitely on battery or solar cells; it therefore has great potential for spacecraft.

The engine takes inert nitrogen gas, changes it to plasma, and accelerates it to a high velocity. To obtain thrust the plasma is forced out a nozzle by a magnetic field. Because the plasma is literally pinched out by short pulses of electromagnetic force, it has been given the name pinch pulse plasma engine.

Before going further, just what is ionized gas, and what is plasma? First of all, a molecule that has lost an electron has a positive charge and is called an ion. An ionized gas therefore is one where sufficient energy has been added to the molecules to free the electrons. If a volume of gas contains an equal number of electrons and ions such that the net charge is zero, it is called plasma. A plasma is characterized by its electrical conductivity, meaning that it can be influenced by outside magnetic or electrical fields.

Briefly then, the nitrogen fuel gas is ionized after injection into the engine. This makes it plasma. Strong magnetic fields accelerate the plasma and compress it toward the center of the circular engine. A nozzle at the engine's center directs the plasma out into the atmosphere creating thrust. This is only one pinch-pulse sequence. These small thrusts are continually occurring in a rapid chain.

Thrust in this engine is low compared to the weight, but because the exhaust velocity is very high, the specific impulse is correspondingly high. (Specific impulse is a term used to show the efficiency of fuel consumption.) For the plasma engine, specific impulse ranges from 1000 to 7000 sec. By comparison, the specific impulse for a rocket engine is 100 to 350 sec. This means a plasma engine can operate for a longer period of time. Exhaust velocities have been measured as high as 100,000 mph with gas temperatures of 200,000 F. Despite these high temperatures, the engine walls stay relatively cool at around 200 to 300 F. Practically no erosion of primary engine components has been encountered in tests to date.

In addition to high specific impulse and low temperature, there are other advantages. The thrust level is variable, controlled by changing the pulse rate. The specific impulse is varied by changing the fuel flow rate to the engine. Since each pinch is a separate operation, dependent only upon the charged condition of the engine's capacitors, the engine may be started or stopped instantly regardless of the time between successive operations of the engine.

The complete plasma propulsion system consists of a basic energy source—solar, chemical, or nuclear; a system to convert the source to electric energy—such as solar cells, or a fuel cell; and the engine system.

The diagram at the right shows the construction and operation of the engine. The nozzle in the center of the engine has the electrodes for building up the magnetic field. The 12 "cans" around the outer edge of the engine contain capacitors that discharge their energy into the ionized gas.

Here is the sequence of events during a single pulse. The electrodes contain an evenly distributed low pressure gas and are connected through a switch to a fully charged capacitor bank before the pulse. The electromagnetic pinch is initiated by throwing the switch, thereby applying the voltage of the capacitors across the electrodes and ionizing the gas. As the gas becomes

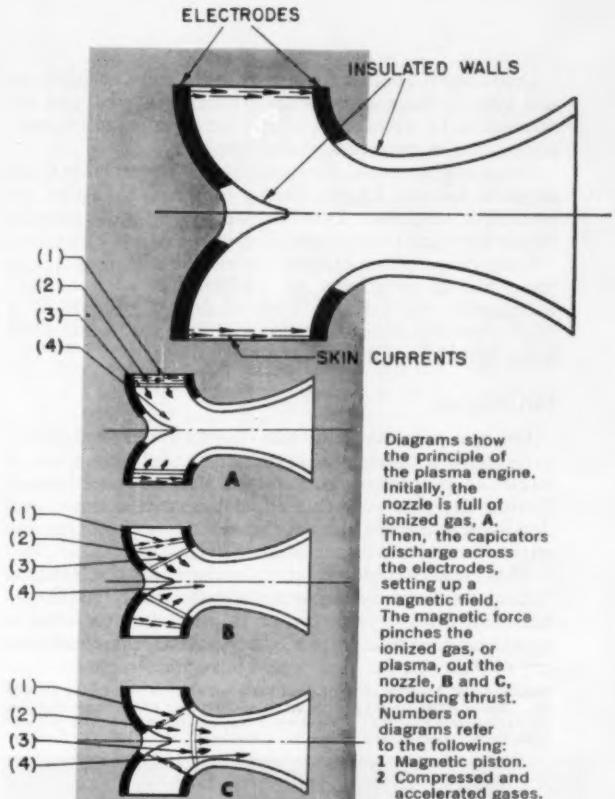
ionized, a current starts to flow, discharging the capacitors. Current growth is extremely rapid and is accompanied by a growing, self-induced magnetic field. The current is maximum at the outside and decreases sharply toward the center of the cylinder. This is called the skin effect. The skin effect is more pronounced as the rate of change of current becomes larger.

The magnetic field is outside the skin current or current sheath with no field within it. The interaction of this magnetic field and the current sheath produces a force or pressure on the gas directed inward toward the axis of the cylinder. This force is a result of the motor action experienced by any element of current in a magnetic field, and is at right angles to both the current and the magnetic field. The effect is as if the current sheath were a heavily stressed elastic band compressing and accelerating the plasma inward. This sheath has been called a magnetic piston, as it acts as a solid piston carrying the plasma before it.

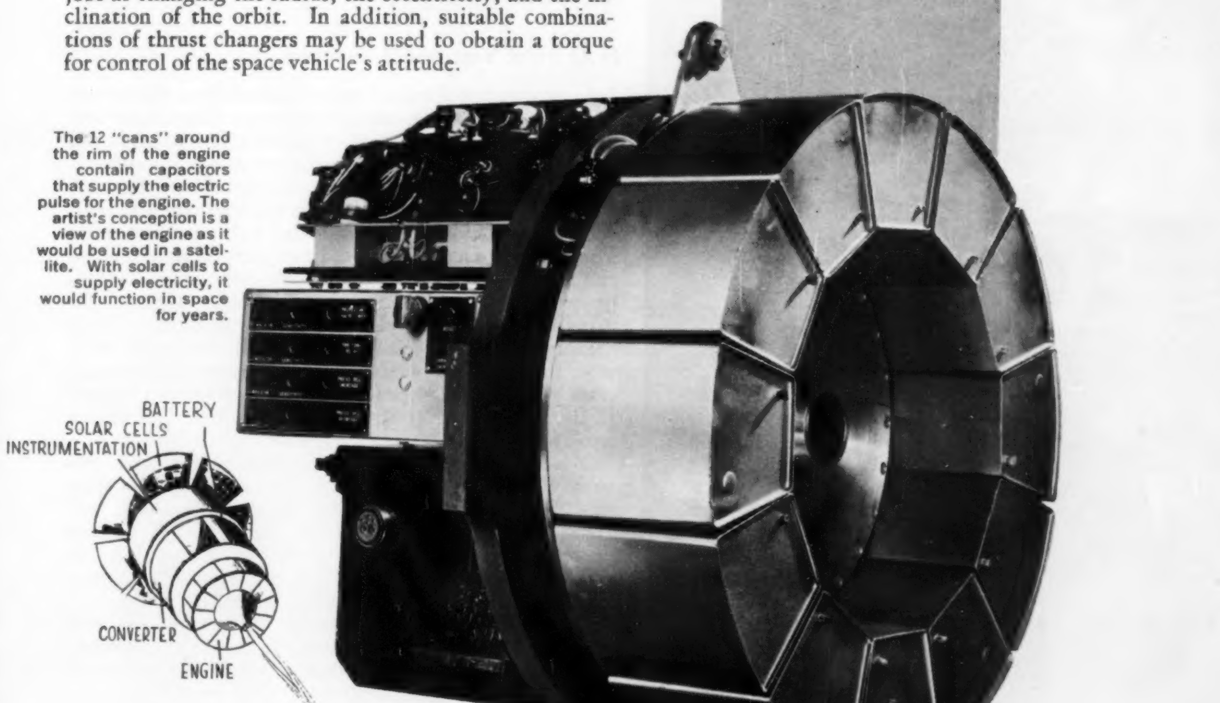
The radial kinetic energy created by compressing the plasma is transformed into axial kinetic energy and the plasma is forced out the nozzle. A careful analysis of the shape of the electrodes is needed to obtain the maximum thrust with the minimum heat loss and nozzle erosion.

The foregoing concerns a single pinch and assumes that all gas is ionized. In practice, the gas is not completely ionized and many molecules are not carried inward by the magnetic piston.

The plasma pinch engine is well suited to those applications where either a long time of operation is required or the weight of fuel is extremely critical. Because of the low thrust-to-weight ratio, this engine may only be used to maintain a vehicle in a particular orbit or make changes in that orbit. Other methods must get the engine into the initial orbit. This engine will have such jobs as changing the radius, the eccentricity, and the inclination of the orbit. In addition, suitable combinations of thrust changers may be used to obtain a torque for control of the space vehicle's attitude.



Diagrams show the principle of the plasma engine. Initially, the nozzle is full of ionized gas, **A**. Then, the capicators discharge across the electrodes, setting up a magnetic field. The magnetic force pinches the ionized gas, or plasma, out the nozzle, **B** and **C**, producing thrust. Numbers on diagrams refer to the following:
1 Magnetic piston.
2 Compressed and accelerated gases.
3 Shock wave.
4 Unaffected gas.



The 12 "cans" around the rim of the engine contain capacitors that supply the electric pulse for the engine. The artist's conception is a view of the engine as it would be used in a satellite. With solar cells to supply electricity, it would function in space for years.

Operational engines for use in space are scheduled for mid-1962. These engines are battery powered and rechargeable by solar cells. They are expected to be capable of years of operation without service.

Other engine work, presently in the research stage, is targeted for the kilo-lb thrust range of electrical air breathing engines. This engine series will provide thrust for space planes operating in the Mach 25 regime.

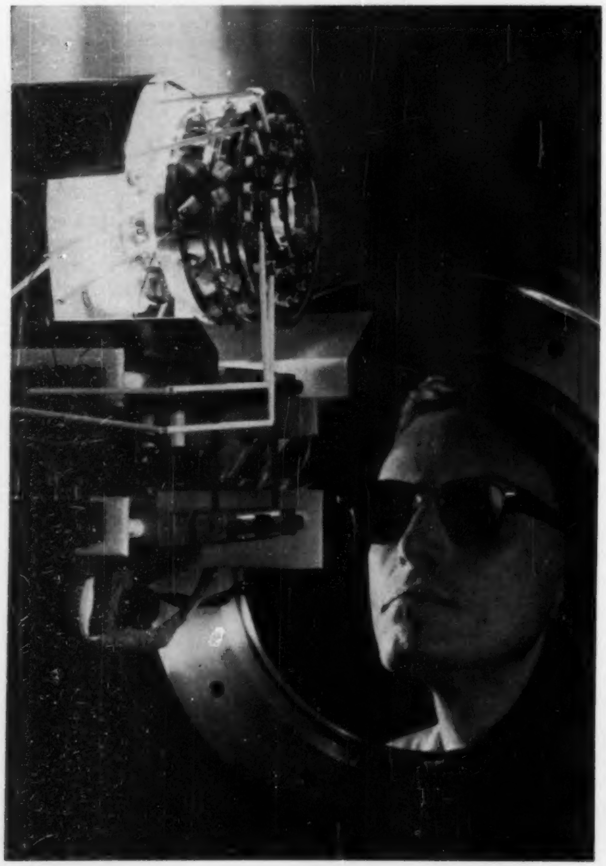
Long-range plans include use of the electrical pinch pulse plasma principles in combination with nuclear thermionic conversion. This engine combination, a nuclear-electric rocket engine, will give thrust values of many hundreds of pounds.

Ion Engine

For the past two years the Hughes Research Laboratories have been engaged in research and development of electrical propulsion engines for use in space travel. During the past year this effort has been directed predominantly toward the development of a prototype ion engine which will take place late in 1962.

This Hughes engine is being developed for the National Aeronautics and Space Administration. It has shown very satisfactory performance in the laboratory and is now being engineered for the rigorous environmental conditions of a rocket launch and probable space flight.

Scientists at Hughes Aircraft test their ion engine in a space simulator. Though the thrust is only 0.1 lb, a cluster of these engines could propel a heavy payload. The engine vaporizes cesium and accelerates its ionized atoms to produce thrust.



The primary source of energy comes from a nuclear reactor, the energy from which is converted to electricity through heat-exchanger and electric generator stages. The NASA and the AEC presently have under development such a nuclear-electric power generating system which will generate up to 60 kw of electrical power for lifetimes of the order of a year.

The electrical power is applied to the ion engine, in which the electric field accelerates positively charged ions to extremely high exhaust velocities. The exhaust velocities are limited only by the voltage applied to the engine and can be greater than 30 times the exhaust velocity of the propellant from a chemical engine and greater than 10 times that from a direct-thrust nuclear engine. In chemical and nuclear engines the exhaust velocity is limited by the energy content of the fuel and by the attainable temperature of the chamber walls, whereas no such temperature limitation exists in the electrical case. The much higher exhaust velocity means that less total propellant weight is needed for a mission; greater payloads are therefore possible.

The propellant used in this type of engine is cesium because of all the possible chemical elements, cesium atoms are most easily converted into ions. This propellant is stored in a reservoir from which cesium vapor is diffused through a hot tungsten element which ionizes the cesium by a process known as contact ionization. There then follows a system of electrodes to which voltage is applied in order to accelerate the ions to a very high exhaust velocity. Finally, the high-velocity ion beam passes through a neutralizer region in which electrons are injected into the ion beam to provide space-charge neutralization of the electric field associated with the positive cesium ions.

If At First You Don't Succeed...

Although the Ranger I moon probe did not achieve its planned orbit, NASA officials were not discouraged and have ordered four more Ranger shots. This extends the series from five to nine. As explained in last September's "Briefing the Record" article, "Ranger Moon Probe," the second stage Agena B was to blast Ranger I into an orbit that would take it more than half a million miles from earth. The Agena B did not perform as scheduled and the Ranger achieved only a low earth orbit. It did, however, carry out some of its missions. Many of the experiments aboard could not function as intended since their operation depended on their being carried on away from the earth's influence. Other elements of the spacecraft were tested according to plan. Ranger I burned in the earth's atmosphere on Aug. 28, after less than a week in orbit.

The second Ranger shot is scheduled for later this year with a mission identical to that of Ranger I. Rangers III through V, the second phase of the series, will take TV pictures of the moon before rough landing on its surface at about 200 mph. Each will land an instrument capsule containing a seismometer, temperature measuring devices, and a radio and antenna.

The recently ordered Rangers, VI through IX, will have high resolution TV cameras and the telemetry necessary to send pictures back to earth in place of the instrument package. They will have no retro rockets as did the previous Rangers, so they will impact the moon at about 6500 mph and be destroyed.

This aluminum oxide element that measures humidity is used in weather data equipment.

Dime-Size Element Measures Humidity

A HUMIDITY-measuring element, smaller than a dime, has been developed at Sandia Corporation, Albuquerque, N. Mex. This aluminum oxide element, which is now under test, has proved superior in many respects to the lithium chloride elements now commonly used to measure relative humidity.

Although these elements were originally developed for use in radiosonde weather data equipment, they can be used wherever size or speed of measurement is important in electric measuring or control devices.

The experimental humidity elements are constructed of two electrodes, or layers of aluminum. The layers are separated by a porous aluminum oxide coating formed by anodizing the surface of either a plate or a foil. The other aluminum electrode is deposited over the anodized coating by an evaporation process. Any change in relative humidity causes a change in impedance between the element's two electrodes. The circuitry connected to the element allows the relative humidity to be read on an indicator.

Here are some of the advantages of the aluminum oxide element:

- Small size—active surface area as small as 0.004 sq in.
- Condensation of moisture on the surface of the element does not permanently affect it.
- The range of the element is 0 to 100 per cent relative humidity.
- Production techniques are conventional and not too costly.
- The elements operate over an extended temperature range (−80 F to 165 with proper correction curves).
- Elements stored in uncontrolled condition over 30 months are still operative.

Snow Melter

SNOW removal is a big problem in New York. With piers and houses going up all along the river, it is becoming more difficult to find a place to dump snow into the river. And, with recent severe winters, the snow does not melt, so thousands of tons float in the rivers to create shipping hazards.

Engineers from Esso offer one solution, a snow-melting machine. This one has the big advantage of portability. It has been built on a trailor bed and can be driven where needed.

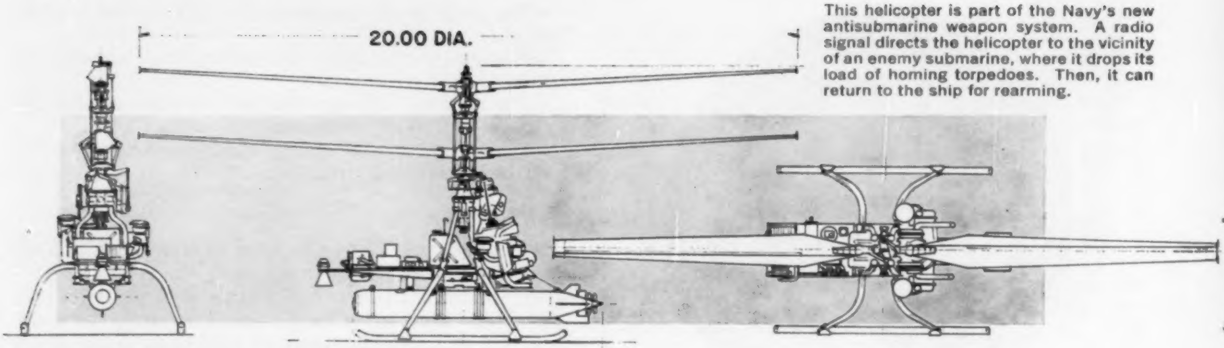
A loader dumps snow into the top of the melter. Inside is a large tank full of agitated and heated water. When the snow contacts the water, it melts almost instantly and drains off into any nearby sewer.

To heat the tank, oil is piped to a 60-gal-per-hr burner at either end of the unit. Air from a blower combines with combustion gas to heat and agitate the water. The principle, called "submerged combustion," uses almost 98 per cent of the oil's gross heating power. Less than two gallons—about 30 cents' worth—melts one ton of snow. It takes an additional five gal of gasoline per hr to power the blower and other accessories.

The unit is designed to melt 75 tons per hr, the equivalent of 40 truck loads. At this rate, water will drain off at about 300 gal a min.

The mobile melter's original concept was discovered by Esso Research and Engineering Co., Linden, N. J. The present form of the equipment was developed, built, and is being marketed by Thermal Research and Engineering Corp., Conshohocken, Pa. This version stemmed from a stationary model originally developed for use at airports, parking lots, service stations, and shopping centers. For the past two years, one such stationary model has operated on a test basis at the LaGuardia Marine Air Terminal, New York. Its performance was the equivalent of clearing 110 tons of snow from a 110,000-sq-ft area in little more than four hr. The unit's rated capacity is 25 tons per hr. Fuel cost was $7.50 an hour representing a savings over trucking of some $50 per hr.

Instead of hauling snow away it can be melted on the spot. This snow melter eliminates hauling costs—and the problem of finding a place to dump the snow. An oil burner inside the unit constantly heats a tank of water. The snow melts almost instantly on contact with the hot water and drains off into a sewer.



This helicopter is part of the Navy's new antisubmarine weapon system. A radio signal directs the helicopter to the vicinity of an enemy submarine, where it drops its load of homing torpedoes. Then, it can return to the ship for rearming.

Drone Helicopter Hunts Submarines

The Navy has recently completed testing the DSN-1, a remote-control drone helicopter that flies from the deck of a destroyer without the risk of a pilot's life. It can fly to an area where sonar has detected an enemy submarine, drop its load of homing torpedoes on command, then fly back to the parent ship for rearming. Since it is unmanned, it can be expendable if for any tactical reason it should not be recalled.

The DSN, made by Gyrodyne Company of America, extends the attack capabilities of the parent destroyer almost to the limit of ship's sonar range. Outmoded ships carrying these helicopters can match more modern enemy submarines.

Destroyers carrying the new weapon will have a heated hanger capable of housing two drones with associated support equipment. There will also be a landing area. The shipboard guidance equipment consists of a standard target control system modified slightly to perform the mission of the DSN.

The helicopter is small, two-bladed coaxial craft with a rotor diameter of 20 ft. Power comes from a 72-hp Gyrodyne/Porsche reciprocating air-cooled engine. Production versions of the helicopter will be powered by a more powerful Boeing turbine engine. The code word for this new weapons system is DASH—for Drone-Anti-Submarine Helicopter.

Home Warning Buzzer

The Office of Civil Defense and Mobilization is considering a $50-million program that will be able to warn 97 per cent of the homes in America of enemy attack.

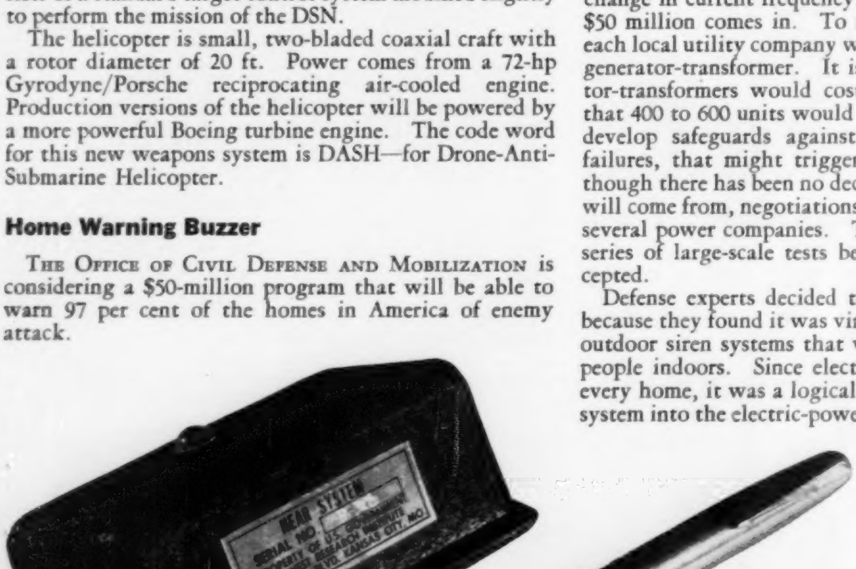
The warning device, called NEAR (National Emergency Alarm Repeater), plugs into a wall socket like any other appliance. As long as standard 60-cycle current is on the line, the box remains quiet. But, when house current shifts from 60 to 240 cycles, the NEAR sounds an alarm.

The program calls for the installation of small boxes (about the size of a cigarette pack) on an electric outlet in each home. When Civil Defense headquarters warns of an attack, all power utility companies will shift the frequency of their current. In each home the NEAR box detects the change and begins to buzz loudly.

To date, only a few pilot models have been made. However, should this program be approved, they will be mass produced and sold nationally for between $5 and $10.

The big difficulty in the program is to bring about the change in current frequency. That is where the cost of $50 million comes in. To make the program possible, each local utility company would have to install a special generator-transformer. It is estimated that the generator-transformers would cost about $60,000 apiece and that 400 to 600 units would be needed. They must also develop safeguards against accidents, such as power failures, that might trigger the warning system. Although there has been no decision as to where the money will come from, negotiations are already under way with several power companies. There will also have to be a series of large-scale tests before the project can be accepted.

Defense experts decided to try this warning method because they found it was virtually impossible to arrange outdoor siren systems that would always be audible to people indoors. Since electric power goes into almost every home, it was a logical step to integrate a warning system into the electric-power network.



If pending tests are successful, there may be one of these black boxes in every home in America. If an enemy were imminent, an electrical signal would go through the nation's power network and cause the box to give a loud buzzing noise.

Nuclear Submarine Summary

The August issue of *Forum Memo* contains a complete listing of all the nuclear submarines commissioned to date. All these subs are equipped with Westinghouse reactors except the *Triton*, which has two General Electric reactors, and the *Tullibee*, which is powered by a Combustion Engineering reactor.

The letters before the submarine's name have the following meanings:

SSN—attack sub
SSBN—ballistic missile (*Polaris*)
SSRN—radar picket
SSGN—guided missile

Twenty-seven more nuclear submarines are now under construction and 13 others have been authorized by the present Congress for a total of 61.

No.	Name	Shipyard	Commissioned
SSN 571	Nautilus	Electric Boat	9-30-54
SSN 575	Seawolf	Electric Boat	3-30-57
SSN 578	Skate	Electric Boat	12-23-57
SSN 579	Swordfish	Portsmouth	9-15-58
SSN 583	Sargo	Mare Island	10- 1-58
SSN 584	Seadragon	Portsmouth	12- 5-59
SSN 585	Skipjack	Electric Boat	4-15-59
SSRN 586	Triton	Electric Boat	11-10-59
SSGN 587	Halibut	Mare Island	1- 4-60
SSN 588	Scamp	Mare Island	6- 5-61
SSN 589	Scorpion	Electric Boat	7-29-60
SSN 590	Sculpin	Ingalls	6- 1-61
SSN 591	Shark	Newport News	2- 9-61
SSN 593	Thresher	Portsmouth	8- 3-61
SSN 597	Tullibee	Electric Boat	11- 9-60
SSBN 598	George Washington	Electric Boat	12-30-59
SSBN 599	Patrick Henry	Electric Boat	4- 9-60
SSBN 600	Theodore Roosevelt	Mare Island	2-13-61
SSBN 601	Robert E. Lee	Newport News	9-16-60
SSBN 602	Abraham Lincoln	Portsmouth	3-11-61
SSBN 608	Ethan Allen	Electric Boat	8- 8-61

Building With Foam

Polyether urethane foam is one of the many plastic products that is creating interest through unique application. Plastic in the form of foam slabs has been used effectively for some time as insulation. Now chemists have learned to alter the foam's makeup to take advantage of more of its properties. They can stiffen the plastic to achieve a foam that has load-bearing as well as insulating properties. There are also new foaming methods. Now you can prefoam the material into slabs to be cut to any size or shape; you can foam it into place so that it penetrates every nook and cranny; or you can spray it on. According to the August issue of Union Carbide's bulletin, *News and Trends*, current consumption of flexible foam is roughly 80 to 90 million lb. The figure may bounce up to 200 million lb by 1965.

Boat builders already are using the new rigid foams in pleasure craft because of the buoyancy and leak resistance contributed by the closed-cell structure. Another important potential customer is the refrigeration field—including frozen foods and transportation. The people who make and operate refrigerator cars and trucks have a weight-to-payload problem, so a thin, light, insulator such as plastic foam is a natural for them. Plastic foam also has the advantage of being virtually leakproof, and its extremely low permeability to water vapor virtually eliminates moisture pickup.

The construction industry will see two new uses of foam: special fireproof foam and rigid foam panels covered with a textured veneer, such as wood.

Air-Supported Structure. In yet another application of plastics, urethane foam is made into large air-supported structures by Raven Industries, Inc., of Sioux Falls, S. Dak. First, they take a balloonlike nylon skin and anchor it to a foundation. They keep this skin inflated with a fan that has a flow great enough to keep the skin taut. Then, a man working inside the skin sprays a sheet of foam in place. When the foam sets, you have a 51 by 20-ft structure ready for occupancy. The nylon skin can be left on or replaced by some more permanent covering. Conventional doors and windows can be installed as needed.

The building's foundation is a footing, about 18 in. below grade, which is reinforced with wire mesh and $^1/_2$-in. rod stock. The mesh extends above the footing and serves as a tie between the foam wall and the foundation.

Average thickness of the foam is 5.66 in. with a density of about 2.3 lb per cu ft. For extra support, there are several archways along the inside. To make them, foam is built up to an extra thickness along a narrow line.

A 20 × 51-ft plastic quonset hut can be put up in a short time with urethane foam. The plastic is sprayed on the interior of a nylon sack while an air compressor keeps the nylon skin inflated to the proper shape.

The completed interior can be easily fitted with conventional windows, doors, and lighting fixtures. Raised sections on the interior are arches sprayed on for extra support. The exterior can keep its nylon sack covering, or replace it by some other protective coating.

In another application of plastic foam, the hull of a 55-ft yacht is sprayed to give it good flotation and insulation characteristics. The foam also deadens water sounds and other external noise.

In the **control room** a complex of instruments monitors every phase of operation at the new Mercer plant of Public Service Electric and Gas Company. On the far wall, TV screens show pictures of the burner flames and water-level gages. At **right** another system continuously measures temperatures at critical points and sounds an alarm when irregularities appear. There are two control consoles, one for each turbine. The other console is at the opposite end of the room. **Outside construction** is another plant feature. Here, feedwater pumps and generators are housed on a deck outside the main building. For maintenance, the aluminum crane handles any lifting chore. **Coal** for the plant is unloaded from river barges and given a preliminary crushing before being sent to the coalyard. An operator regulates the distribution of the coal remotely. He controls the swing of the large boom with the help of a TV monitor.

Public Service Opens New Mercer Station

MERCER generating station, located on the Delaware River south of Trenton, N. J., is the newest addition to the electric generating system of the Public Service Electric and Gas Company. This $110,000,000 plant has two identical cross-compound 3600/3600 rpm units with a 320,000-kw nominal rating at throttle steam conditions of 2400 psig and 1100 F, with reheating to 1050 F. The turbines are 24-stage machines with nine pressure stages in the high-pressure element, seven stages in the double-flow reheat section, two stages in the double-flow intermediate-pressure turbine, and six stages in the two triple-flow low-pressure elements.

Steam for feedwater heating is extracted from two points of the high-pressure turbine, three points of the reheat turbine, and three points in the low-pressure turbine, making a total of eight. The bulky steam piping connecting the cross-compound elements of each turbine is concealed beneath the floor to permit maintenance work on all shafts without removing it. The low-pressure cylinders and generators are duplicates.

A half-capacity boiler feed pump is driven from the outboard end of each generator. Each generator and its associated boiler feed pump are located out-of-doors on the generator deck.

Each 320,000-kw cross-compound main turbine drives two identical, conventionally cooled generators, rated 192,000 kva at 85 per cent power factor with a 30-psig hydrogen pressure.

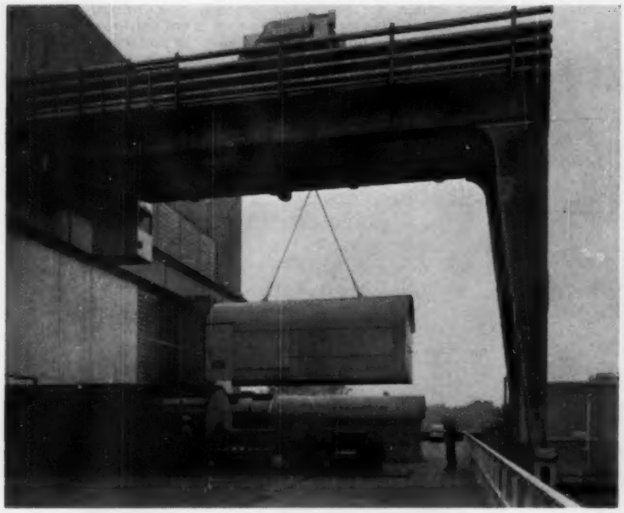
Control Room. Each unit is operated from a separate console in the air-conditioned control room. The indicators and controls necessary to start, stop, and operate all of the equipment associated with each unit are located on its console. Recorders for performance calculations and historical data are located throughout the station conveniently near the sensing points. No liquid or hazardous gas-sensing lines are brought into the control room, all signals to indicators and controls being electrically or pneumatically telemetered. Miniature strip charts are provided in the control room to give the operators trend data where required. Television has been utilized for viewing the chimney emission, furnace burner conditions, boiler gage glasses, and the main entrance gate. Direct-reading drum-level indicators, and drum-pressure gages, viewed through a window, are located outside the control room in keeping with the philosophy of having no high-pressure lines inside the room. The combustion, feedwater, and steam temperature control systems are all electric. With the exception of the feedwater and superheat control valves, which have an electropneumatic converter, all of the boiler control drives are electric.

A data logger is provided in the control room to keep the operators apprised of the important temperatures in the plant. In its scan and off-normal functions, the logger continuously scans 600 thermocouple temperatures, comparing them with predetermined set points. If values are encountered beyond the predetermined set points, a red print-out of the time, point designation, and temperature magnitude is made, and an alarm is sounded. The operator can then take corrective measures. When a temperature returns to its normal point, a black print-out occurs, giving the same information as above, and an alarm is sounded.

The trend function of the logger permits the operator to select as many as ten temperatures which will print out the time and the temperature of the points selected once each scan cycle. If, in emergency, the typewriter should be out of service, the operator can manually select a particular temperature point to be monitored. The log function enables the operator, on demand, to log out all 600 temperature points.

The performance computer is a digital, stored-program, synchronous computer with a 16,000-word capacity. It is capable of calculating and printing out station performance reports for weekly, monthly, quarterly, and yearly periods. On demand, the computer can perform operating tests on main equipment for any period chosen by the operator. In addition, the computer can provide continuous operating guides, such as unit heat rate and boiler efficiency, from which actual operation is compared to bogie operation. With these guides, the control set points can be manually adjusted to optimize unit performance.

Fuel Supply. The coal-handling system is designed for receiving coal either by barge or by ocean-going colliers. A stationary unloading tower is provided on the mooring crib-type dock.



In the bulk-storage system, the coal is processed through a 14 by 22-ft breaker, which discharges a $2^1/_2$-in. product via a belt feeder to two 470-ton-per-hr ring mill granulators which reduce the coal to a $1^1/_4$-in. product. The coal is then conveyed to the swing boom tower where it is discharged through a telescopic spout to the 13,000-ton active storage pile which is built up over three ground-level conical reclaim hoppers.

A single-belt system conveys the coal from any of the three reclaim hoppers to a transfer-chute over the coal silos. Here the system divides and feeds separately through a short belt scale and a Redler conveyer to the six silos of each unit. The common portion of the conveyer system has a dual-speed capacity of 150 or 300 tons per hr to permit serving either unit alone or both units simultaneously. The system is automatic and is controlled by the level devices in the silos.

Two silos feed each of the three ball-type pulverizers for each unit through table-type feeders. These feeders automatically supply coal as required by the pulverizers. Primary air is blown through the pulverizers to carry the pulverized coal to the boiler burners. A natural gas system provides for boiler firing as a supplementary fuel on an interruptible basis, and for burner ignition on a firm basis.

Steam Generating Units. Steam for the two turbine-generator units is supplied by two identical, natural circulation, steam generators, each having a continuous rating of 2,060,000 lb per hr, with throttle conditions of 2400 psig and 1100 F, with reheat steam temperature of 1050 F. Each boiler has two pressurized, wet-bottom furnaces equipped with slag-traps. Fuel is fired through 12 combination coal and gas burners on three levels in the front wall of each furnace. The 24 burners in each unit are divided into two groups of eight and two groups of four burners. Each burner has an igniter. The burner and igniter groups are designed for remote operation from the control room console.

Each furnace contains a radiant superheater which forms the upper portion of the four furnace walls. All the steam from the radiant superheaters flows to a convection-type finishing superheater located in one furnace. A convection-type reheater has been located in the corresponding area of the other steam generator.

All of the draft equipment is located out-of-doors near the ground level between the boiler and the chimney. Two variable-speed forced-draft fans supply combustion air to each boiler through the air heaters. The fans are connected to constant-speed driving motors through hydraulic couplings.

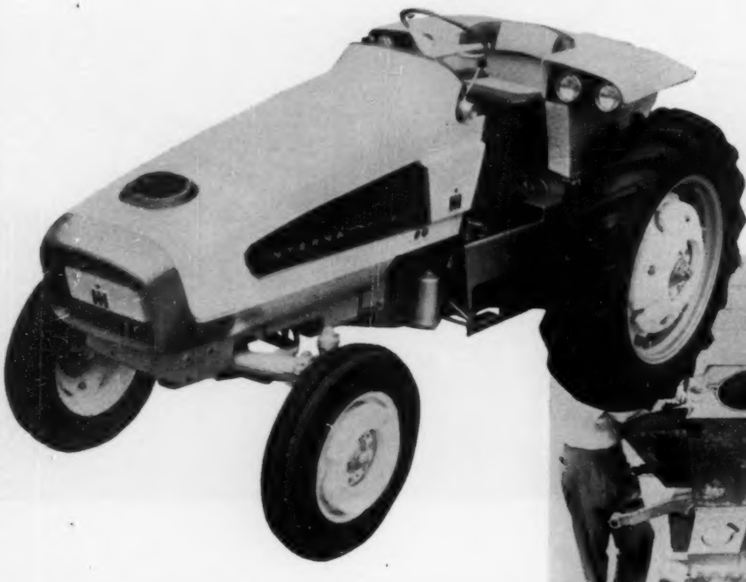
The two furnaces of each boiler have slagging bottoms arranged for continuous discharge to two separate slag tanks.

Roughly, two thirds of the steam entering the turbine expands through all the stages and exhausts to the condenser. The other third is extracted from the turbine and reaches the condenser as drains from the feedwater heaters.

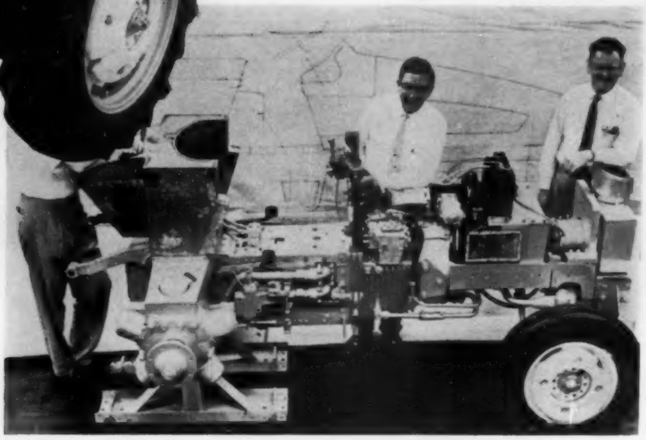
Pumps. Two high-speed, half-capacity boiler feed pumps and a one-quarter capacity pump serve each unit. The two main pumps are driven from extensions of the two 3600-rpm generator shafts, continuing the symmetrical arrangement of components. The drive includes a variable-speed hydraulic coupling and a speed-increaser designed to run at a maximum speed of 8986 rpm. The third pump, a quarter-capacity spare, is driven by a 3600-rpm motor at constant speed through a speed-increaser.

Feedwater. The feedwater heating cycle includes eight stages of heating and extensive use of condensate for cooling. Six heaters and three external drain coolers are on the suction side of the boiler feed pumps, and two high-pressure heaters are on the discharge side. The six low-pressure heaters and three drain coolers are arranged in a double string with a common bypass. The heaters of the three lowest stages of heating are located horizontally in the condenser necks to save space and to cut down the length of the bleed piping. The two high-pressure heaters are also arranged in a double string with a common bypass.

Fire Protection. Automatic fog-type water-spray systems protect the main and auxiliary transformers, turbine oil storage and purification units, hydrogen and seal oil units for the turbine-generators, boiler feed pump hydraulic coupling and bearing oil coolers, and the underground coal conveyer tunnels.



Except for the large wheels, this tractor might pass for a sports car. It is not only new externally but internally as well. It has a gas turbine for a power plant which drives an oil pump. The pump in turn sends oil to radial motors at each rear wheel. The motors at the wheels have oil pressure instead of expanding gas to push their pistons. The driver needs only one control, for acceleration and braking, aside from the steering wheel.



Gearless Tractor

International Harvester's new research tractor looks like a sports car on tractor wheels. But, the big innovations are inside the fiberglass body. There is a gas turbine in place of the usual piston engine, and a hydrostatic transmission instead of the usual transmission and drive shaft. Only the wheels and frame remain from the old style tractor.

The controls for this renovated tractor are quite simple. To start, the operator need only push a button and an automatic sequence box takes over. After that, except for steering, he is concerned with only one control—the transmission lever. This single lever selects forward or reverse, controls the speed, and does the braking.

There is a sharp distinction between the hydrostatic drive used on this tractor and the hydrokinetic drive commonly used in automobiles. In the tractor, oil drives the wheels without slippage, as if the gears and shafts were solid. The tractor's response to the transmission controls is immediate and solid. On the other hand, there is a lot of slipping between the engine and the driving wheels before the hydrokinetic drive can operate in an automobile.

The designers were not troubled by the usual large components, so they were able to give the tractor a unique appearance. For example, there are four headlights mounted on the rear fenders. The two inner lights give good visibility when using side-mounted attachments, while the outer two are for road driving and general illumination for night work.

There are four major components to the driving system: the turbine, the pump, and two radial motors. The turbine drives the pump at constant speed; the pump supplies oil under pressure to the radial motors; the motors drive the tractor's wheels.

The pump sends oil, under pressure, to a radial motor at each wheel. (These motors resemble radial aircraft piston engines.) In this case, oil instead of expanding combustion gas moves the pistons. The piston rods are linked to an eccentric which in turn is connected to the wheel.

The pump which is powered by the turbine and supplies oil to the motors is the key to the tractor's simple control. Although the pump turns at a constant rate, the quantity of oil it moves can be varied. A swashplate, linked to the control lever, changes the pump's displacement. By changing the angle of the swashplate, the flow of oil to the radial motors increases or decreases and, consequently, so does the tractor's speed.

To change direction, just move the control lever to reverse position and the pump reverses the direction of oil flow. Move the control lever to neutral, pump pressure stops, and the system acts as a positive brake on the wheels.

Each wheel has its own driving motor so it is possible to shut off pressure to a single wheel when desired. This brakes one wheel and directs all the driving pressure to the other for very short turns.

The tractor's gas turbine, an 80-hp, single-shaft Titan T62T, is a product of the Solar Aircraft Company, Harvester's San Diego subsidiary. The power plant is 21 in. long, less than 13 in. in diam, and weighs only 90 lb with reduction gearing.

The Titan is similar to other turbines in operation. It draws in air, compresses it, then mixes the air with fuel in the combustion chamber. After the mixture is ignited, the hot gases spin a vaned turbine wheel. The turbine turns the output shaft directly, producing constant engine speed. Gearing reduces speed of the turbine's output shaft to 2000 rpm.

Its simple design creates such advantages as:

Freedom from vibration—a smoothly spinning turbine wheel and shaft replaces the reciprocating masses of the piston engine.

Freedom from conventional maintenance problems.

Very low oil consumption since it has only a few bearings.

It starts readily at low temperature.

Virtually any kind of liquid fuel can run it.

Torque characteristics are said to be excellent, and response to its transmission control is immediate and solid throughout its speed range (11 mph maximum).

Since the turbine engine needs little servicing, the stylists could design a hood that enclosed the engine completely—in contrast with the traditional tractor engines with their sides exposed.

There are, however, a few items on the debit side.

At this point in the research program there are still some problems to be solved before the tractor goes into production.

First, there are no claims for the tractor's fuel economy. Heat exchangers or regenerators might help to bring it up. They could recover heat from the exhaust for preheating intake air and increase the efficiency.

Noise is another problem. The turbine is no louder at full throttle than in a conventional tractor, but the turbine seems noisier. This is partially due to the higher frequency of its pitch. It is known, however, that the turbine can be silenced.

More research has to be done with heat-resistant materials and precise production methods before the gas turbine can become competitive. Currently, low volume production of components for the turbine as well as for the hydrostatic transmission would place the price of this new tractor far beyond the reach of the average customer.

Koppers Has New Research Center

The Koppers Company, Inc., dedicated its new research center at Somervell Park, Monroeville, Pa., on August 28th. This 176-acre facility represents an investment of about $8.5 million.

The center presently consists of a five-story administration building, three three-story interconnecting laboratory wings, and several auxiliary buildings. Design of the center allows for plenty of expansion. For example, the glass-enclosed stairways at the end of each wing can be removed, the wing expanded, then the stairs reaffixed to the new bigger wing. The boiler room also has space to handle any increase in size.

About 15 years ago, the Koppers Company moved into the field of chemicals and plastics, after concentrating their work in engineering and construction. The new fields called for an accelerated research program. Through the years their research program has continued to expand. When the company's research center at Verona, Pa., became crowded, they planned and built the Somervell center.

Although the center will eventually house 1500 scientists and their assistants, the present staff numbers about 400—275 at Somervell and 125 at Verona.

Most projects undertaken at Somervell are initiated co-operatively between the research department and the various operating divisions to meet specific market or production needs. Other projects, which are often unrelated to present product lines, look farther into the future. They are undertaken by the Exploratory Section of the Research Department. Products developed by this section may be turned over to the Research Department's Evaluation Sales Section for market exploration purposes. There, research scientists work with customers and potential customers in test marketing new materials and new processes to gage areas of interest in a given product. Their work helps determine whether the potential is large enough to turn over a product for full commercialization.

To support their research people in their work, the center has a complete library. It receives more than 350 scientific journals from all over the world. Translations of many papers and reports from many countries are available to the personnel.

Other support facilities include a patent section which secures and maintains patent, trademark, and copywrite protection. The patent section also draws up research contracts and is responsible for patent searches that bear on any given project. The scientists even have their own glass blower who can make special lab equipment to individual specifications.

To illustrate the work that is going on at the new research center, here are a few areas of activity:

Chemicals—coal-tars, organic boron compounds, chemical intermediates, polymers, and high-temperature chemical synthesis.

Plastics—Dylite expandable polystyrene, Dylan low-density polyethylene, KER epoxy resins.

Steelmaking—movable-wall coke oven, iron ore reduction, the profilimeter (gives a picture of a blast furnace charge).

Dyestuffs—Alofast dyes, Amacron dyes for polyester fibers.

Building materials—waterproof Penacolite adhesives, decay-resistant lumber, and fire-protected wood.

. . . salt-water conversion, packaging, wood preservation, corrosion prevention, and others.

High-temperature chemical synthesis studies use this plasma gun. Its stream of ionized gas reaches temperatures as high as 25,000 F. This is one of the areas of study at the new Koppers Research Center.

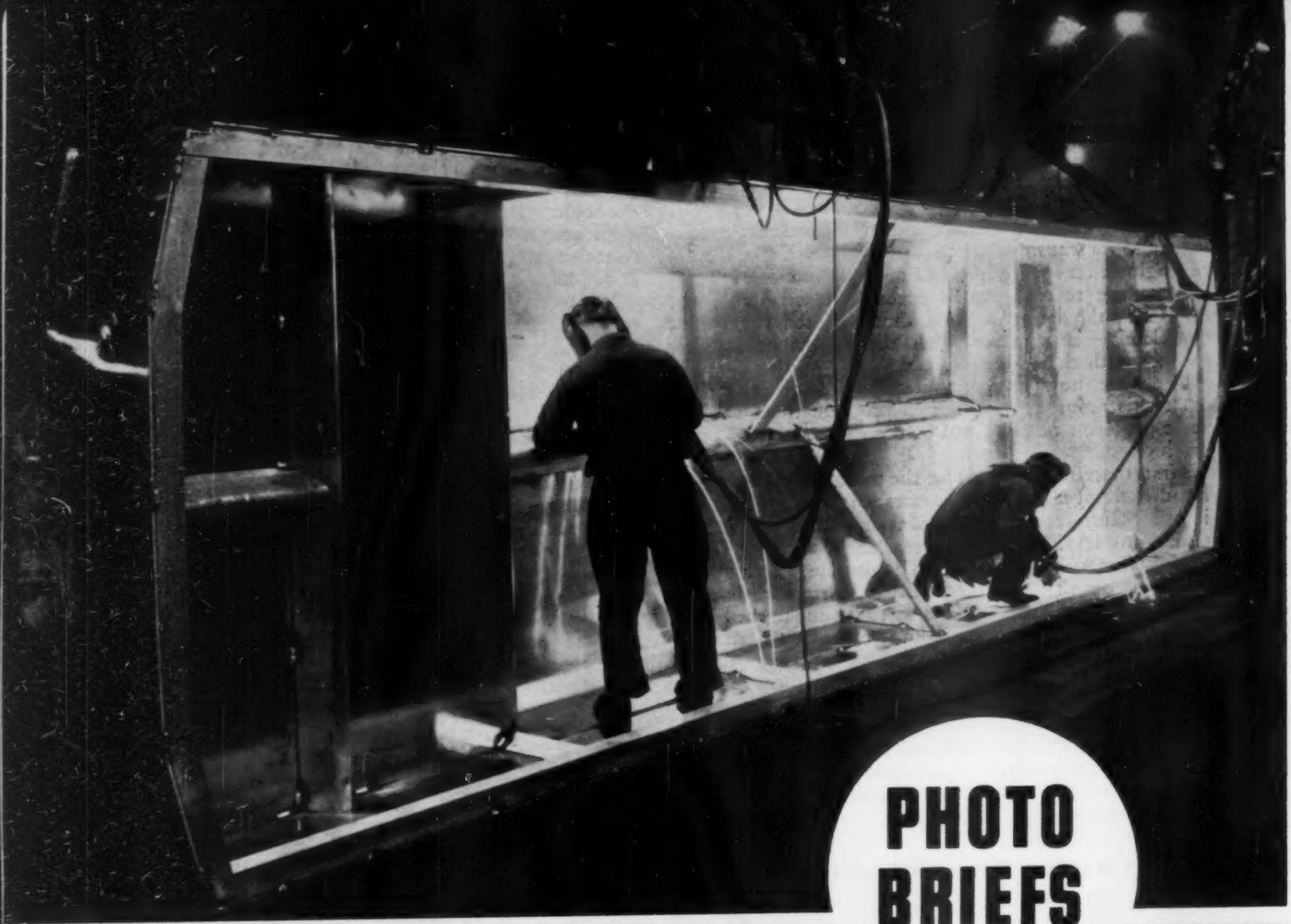
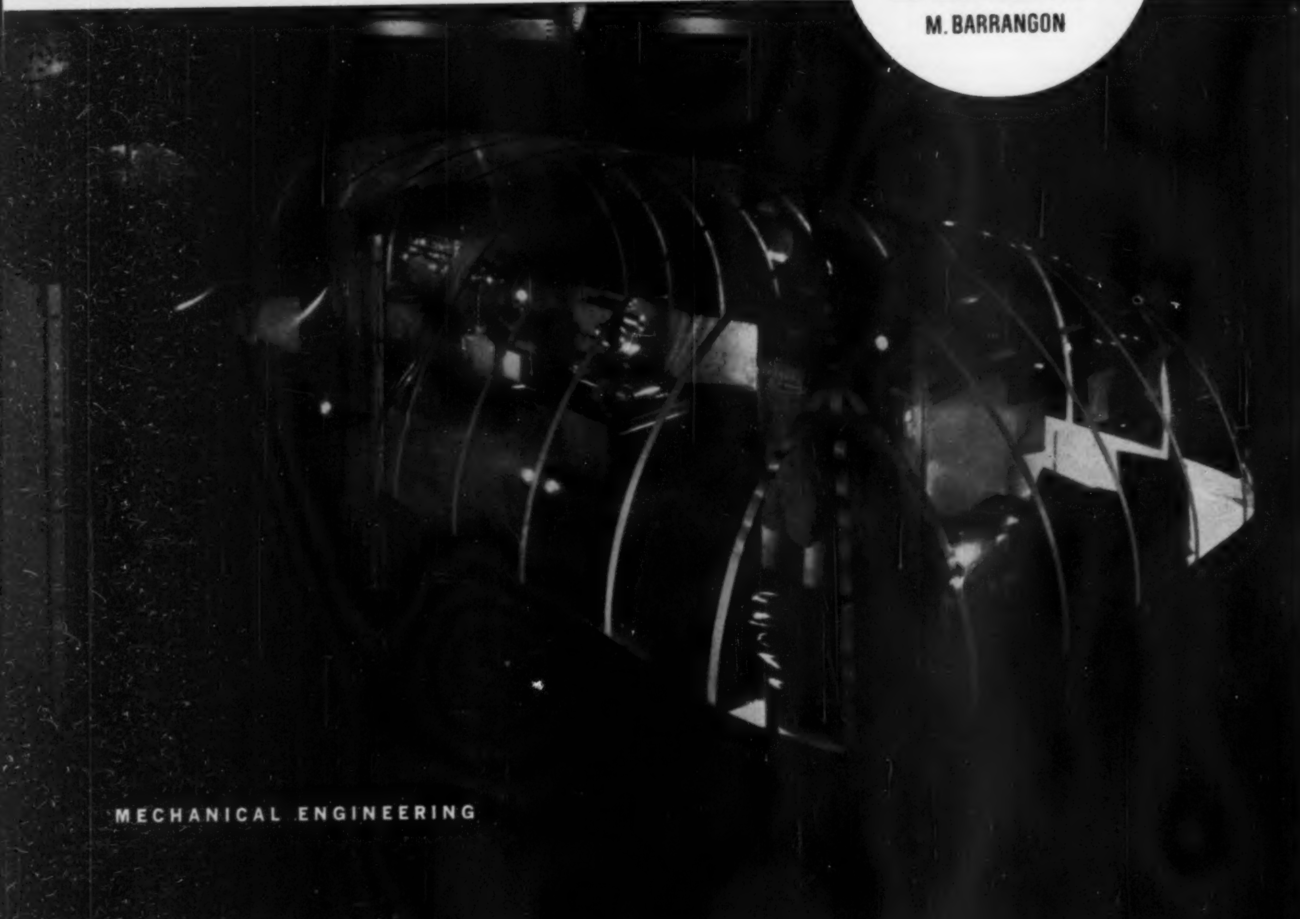


PHOTO BRIEFS

M. BARRANGON



1 ALUMINUM MINE CAR. Irwin-Sensenich Corporation, Irwin, Pa., is making 125 of these coal-mine cars from aluminum plate, extrusions, and castings supplied by Alcoa. Weight: About 3 tons, as compared to 5 tons and up for steel cars. Tests on 20 experimental cars showed not only more-cars-per-train, due to lighter weight, but also greater resistance to structural damage. In addition, the aluminum cars dump cleaner, are more corrosion resistant in mine environments, and require no painting to make them visible in dark tunnels. **2 AIR-CONDITIONED MACHINE TOOL.** The R. K. LeBlond Machine Tool Company, Cincinnati, Ohio, uses this plastic "bubble" to provide proper temperature and air conditioning for adjusting lathes with their tape-control systems. The plastic structure is made by Airshelter, Inc., of Nicholasville, Ky., is 12 ft by 25 ft, with 9-ft headroom, has an air-lock entrance and 10-ton air conditioner. It's portable—can be moved from one lathe to another—and has maintained temperatures within 5 F when shop temperatures varied as much as 25 F. **3 UNDERWATER PLANE.** This T-14 "Pegasus" submarine plane is the basic model of a projected series of underwater vehicles. The "jeep of the deep" is said to carry a rider speedily and safely on missions of search, survey, and exploration under the sea, its unique control system permitting it to dive, climb, turn, and roll underwater with the ease of an aircraft in flight. Loral Electronics Corporation, New York, N. Y., has acquired this and other inventions of Dr. Dimitri Rebikoff, French inventor, who will join Loral as technical director of the new project. **4 SOLAR CONCENTRATOR.** This dish-shaped mirror will focus the sun's rays on the cathode of a thermionic converter, converting solar heat into electric power—for space ships. The Boeing Aero-Space Division's physics technology department developed the mirror. The reflective surface is composed of vacuum-deposited layers of silicon monoxide and aluminum. Structural rigidity is maintained by sandwiching 1/2-in. aluminum honeycomb between layers of epoxy-impregnated fiberglass.

Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

Automatic Chucking Lathe

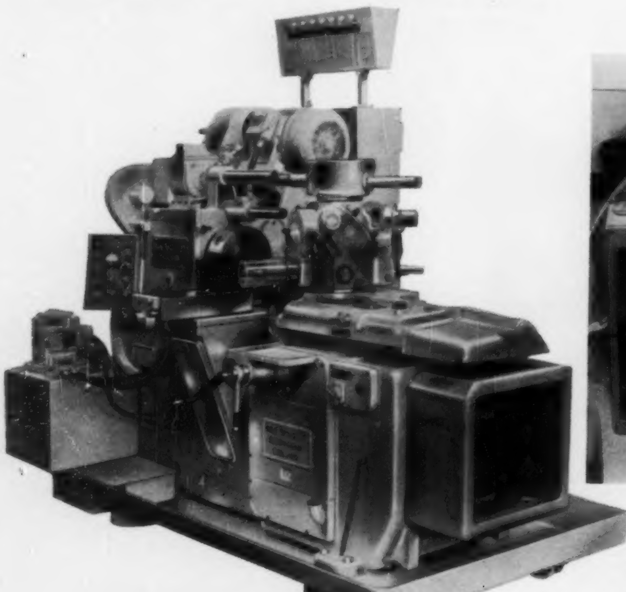
At Brussels there were probably three times as many machines fitted with some form of program control as there were at the Sixth European Machine Tool Exihibition held in Paris only two years ago. Punched tape seemed to be the most popular type, but that is not the only method. The use of a studded band or chain-belt to operate switches (usually to control compressed air or pressure oil) has not extended noticeably, but there was an interesting variant on the same principle on the stand of B.S.A. Tools, Ltd., of Birmingham, England, incorporated in their No. 95 all-electric automatic chucking lathe.

The lathe itself is standard, having a turret with five sets of toolholders. There are ten speed ranges, giving 30 spindle speeds. Three of the speed changes are automatic. Power for two of them is applied through electromagnetic clutches and for the third (the slow speed) through a freewheel type of sprag clutch. Drive to the feedbox is by chain from the headstock through a feed transmission box and a coupled shaft.

All drives and controls are electric, and there is a separate motor to give a fast movement during tool withdrawal and turret indexing.

The entire operation of the lathe, including feed selection, is controlled by impulses transmitted from the "Discotrol" program control unit, the essential feature of which is a thin steel disk having small indentations impressed into it at different radii. As the disk revolves these actuate the microswitches. The disk is readily mounted or removed, being held only by a single central bolt, and can be conveniently stored after use like a gramophone record. Thus it is a simple matter to make only a single component on short notice.

To prepare the program a blank disk is inserted and an unmachined workpiece is placed in the chuck. This is machined to the required dimensions, the microswitches being operated by hand. At each stage in the machining the hand-operated punch is applied to emboss the corresponding instruction on the disk. When all the necessary impressions have been made in the disk, the punch mechanism is removed, the hinged panel of switches is closed, and the lathe is then ready to repeat the sequence of operations automatically.



Automatic chucking lathe, left, is programmed by embossed disk. The first workpiece of a number to be made is machined through hand manipulation of the controls. At each step in the making of the piece, the blank disk is embossed by hand with a punch lever, above. Thereafter, punch mechanism is removed, hinged panel of limit switches at front of lathe is closed, and machine works from programmed disk to make pieces.

All-Round Photography

A CAMERA for photographing the curved surfaces of cylindrical objects has been developed in the Thornton Research Center, Chester, England, of the Shell International Petroleum Co. It operates by building up a picture of the curved surface in narrow strips, and can be used on internal as well as external surfaces.

The camera is a "Peco" Supra II, made by the German firm of Plaubel, of Frankfurt-am-Main, and takes plates 4 in. by 5 in. The special feature is a traversing back that moves the film by uniform steps along a straight track. The back is light-tight save for a slit, adjustable for width and removable for focusing. The exposure of the film is proportional to the slit width and is about one sec for a slit 0.02 in. wide.

The object to be photographed is mounted on a turntable that turns at the rate of one revolution in 192 sec by a 115-volt 50-cps two-phase synchronous motor, suitably geared, which is housed in the base. Reference lines and an index scale enable the operator to uncap and recap the lens at the right moment to insure that the resulting photograph covers exactly 360 deg of the surface. Contacts on the turntable cause a buzzer to sound 30 sec before the rotation is completed, warning the operator to be ready to cap the lens.

The slide in the back of the camera is traversed by another geared synchronous motor along a hardened and ground micrometer lead screw of 40 tpi, with a spring-loaded split nut. The purpose of the split nut is to enable the slide to be quickly reset by hand to its starting position. A microswitch cuts off power from the motor at the end of the traverse, which is slightly over 4 in. The slit is formed by two hardened and ground knife edges. Their distance apart is adjustable by means of a knurled screw between 0.003 in. and 0.040 in., the setting being indicated on a calibrated disk. The camera can photograph objects as small as revolver bullets and as large as automobile tires, and can also be used to compress long traces such as those produced by pen recorders on the graphs of scientific apparatus.

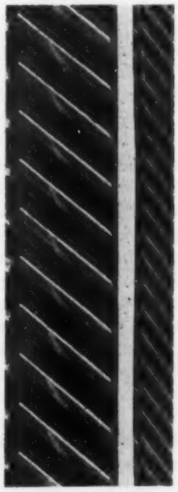
Machine Tool Exhibition

THE Seventh European Machine Tool Exhibition, which opened in Brussels on September 3 and continued through September 12, was an impressive display. Even though many of the exhibits differed little from those shown in the previous Exhibition held in Paris in 1959, there were many detailed improvements, especially a considerable increase in the use of automatic controls, mainly by punched tape apparatus.

The Palais du Centenaire, where the exhibition was held, provides eight large halls with wide gangways and ample space for the machines. A ninth hall, the Palais Européen, served admirably as a common center in which each of the national organizing bodies had its individual information office. In addition, the spacious Patio, centrally placed in the rear of the main hall, served to concentrate in one place the stands of the numerous technical publications concerned with machine tools and their production, marketing, and use.

No exhibits were sent directly from the United States, the exhibition being strictly confined to the products of actual makers from the ten European countries represented on the organizing committee. But a number of important American firms now have licensing arrangements with European manufacturers, who thus were enabled to show machines made in Europe to American designs. Among the 1000 or so exhibitors, German firms were the most numerous national group, followed by French, Italian, Swiss, and British, in that order. This, of course, does not necessarily reflect the comparative size of the machine-tool industries of those countries. Transport problems have much to do with it.

Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.



Shell periphery camera, **right**, photographs curved surface of revolving globe by means of moving back that carries film by uniform steps along a straight track. **At left** are 360-deg periphery photographs of skew gear and pinion, **below**.

Substance in Brief of Papers Presented at ASME Meetings

KAREN SODERQUIST
Editorial Asst.

ASME TECHNICAL DIGEST

Petroleum Mechanical Engineering

Simulation of the Gas Transmission Industry..61—SA-12...By Edward Gordon, United Gas Corporation, Shreveport, La. 1961 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1962).

Simulation techniques have been found useful in a variety of applications. Perhaps the most important of these applications is in the form of a "management game," which provides an extremely effective aid to teachers of management courses. Such a management game has been created for the natural gas-transmission industry based upon a flexible model programmed for the Datatron 204. Precise simulation of any actual situation in the gas-transmission industry is not essential for training purposes. All that is important is that the model adequately and vividly demonstrate the features peculiar to this industry.

This management game is intended for use as part of appropriate courses to be conducted by the personnel department. A training manual and necessary detailed instructions for playing the game will be provided the participants during the course. The participants should be grouped into teams. Each team is to run a particular company and is furnished with appropriate information about the status of the company, its competitors, and of the industry at the time of the start of the game. This information is presented in the form of reports. Each company has a fictitious board of directors in the person of the game administrator. This gives the administrator the opportunity to exert control over the dividend-payment policy and other matters when deemed necessary to satisfy the "stockholders."

Although the simulation model was not created for strategy-evaluation studies, it may be useful for that purpose also. This would require further studies to determine the constants to use in the model to simulate as accurately as possible what has actually happened in the gas-transmission industry during periods and situations of interest.

A New Approach to Digital Computer Solution of Gas Networks Based on Kirchhoff's First Law..61—SA-13...By Max A. Dengler, Mem. ASME, and James P. Siken, Arizona Public Service Company, Phoenix, Ariz. 1961 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1962).

A method is developed for the determination of the pressure variation within a network of pipes for the supply and distribution of natural gas. The analysis is based on Kirchhoff's first law and the fundamental assumption that the flow along a tube is proportional to a power of the pressure differential of the end points. Initial pressure values are assumed.

The corresponding nodal flow unbalances are improved, that is reduced, by repeated application of an iterative procedure being referred to as derivative iteration. Systematic reduction of the flow unbalances leads to the pressure distribution of the network. The proof for unconditional convergence of the method is established. Steps for convergence acceleration are indicated. A general description of the program is given with illustrations of input and output data and time estimates for the IBM 704. Future applications are discussed.

Effect of Prestrain on the Fatigue Properties of Steel..61—SA-17...By John F. Gormley, Assoc. Mem. ASME, Reed Roller Bit Company, Houston, Texas. 1961 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1962).

It is fairly well known that if a piece of steel is loaded in tension or compression to some point past the yield strength of the material, subsequent testing in that same direction will show the metal to have higher yield strength. Less well known is the fact that if the first yielding is done in tension, then subsequent loading in compression, the steel will show a great reduction in the yield strength. This reduction of strength in one direction, after cold plastic deformation in the other direction, is known as the "Bauschinger effect."

Several facets of the Bauschinger effect needed further investigation, including the influence of plastic prestrain on the fatigue properties and the influence of time at temperature for removal of the Bauschinger effect.

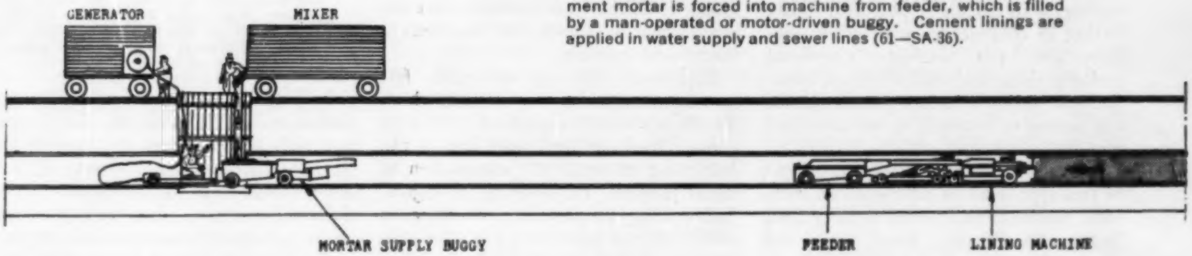
Tests to determine the effect of overtorquing tool joints on their fatigue strength were conducted. Type AISI 4137 H steel was used for testing since this material is commonly used in tool joints. The paper reports results of the investigation and means for alleviating damage done by plastic prestrain.

Press Forming and Welding of Heavy Magnesium Plate..61—SA-18...By R. A. Matuszeski and A. J. Kish, ACF Industries, Inc., Albuquerque, N. M. 1961 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1962).

The majority of experience in forming and welding of magnesium has been confined to thin sheet materials. Certain processing difficulties can be encountered when similar fabrication techniques are applied to thick sections of one inch and greater. This paper describes the techniques used to press from one to two-inch-thick AZ31B magnesium and the resultant properties of the pressed shape. A discussion of welding technique and across-weld properties is presented for one-inch-thick AZ31B, as well as general discussion on welding thicker plate of the same alloy.

Based on the findings of this evaluation, as well as substantial subsequent evaluations, it is concluded that sound welds can be produced in thick magnesium plate producing satisfactory mechanical properties and high joint efficiencies.

Machines for cement-lining of pipes 24 to 144, in., inclusive, are wheel-mounted and electric-motor-driven, and equipped with trowels to smooth the cement surface. Units are controlled by operator on trolley coupled to lining machine. Cement mortar is forced into machine from feeder, which is filled by a man-operated or motor-driven buggy. Cement linings are applied in water supply and sewer lines (61—SA-36).



Protection of Cooling-Water Piping Systems Against Seawater Corrosion..61—SA-36...By J. Goudriaan, Bataafse Internationale, Petroleum MIJ, M. V., The Hague, The Netherlands. 1961 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1962).

The protection of cooling-water piping systems against seawater corrosion is a problem encountered by all seaboard refineries. A continuous search is going on to determine the best and most economical materials and coatings for the service conditions involved. The purpose of this paper is to outline and disclose briefly the various materials and methods of protection that are used in the seaboard refineries of the Royal Dutch/Shell Group. A more detailed description is given of the "in situ" cement lining method which is not only used to protect new piping systems, but also to rehabilitate old ones which would either require replacement or major repairs.

The following piping systems are discussed: (*a*) unlined piping systems made of cast iron and PVC plastic, (*b*) bitumen-lined steel piping systems, (*c*) epoxy-lined steel piping systems, (*d*) cement-lined steel piping systems.

A Comparison of United States, European and British Commonwealth Codes for the Construction of Welded Boilers and Pressure Vessels..61—SA-40...By J. F. Lancaster, Kellogg International Corporation, London, England. 1961 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1962).

Because of the inherent hazard involved in their use, the construction of boilers and pressure vessels is subject to regulation by a government department in most of the countries surveyed. The degree of legal control varies a great deal; on the one hand there are countries such as Italy and Austria where rules for construction are set out in detail in a ministerial decree, and others, such as India and New Zealand, where the code is written and issued by a government department and is a ministry regulation.

At the opposite extreme, in the United Kingdom of Great Britain the law gives the very minimum of guidance as to means of construction. Other countries, such as the United States, Canada, and Australia, have adopted a method of regulation which lies between these two extremes; the government or local authorities give approval to a code which is written by a body of professional engineers, thereby vesting this independent code with the authority of law.

The boiler and pressure vessel codes of a number of European countries and of the United States and Canada are compared. The provisions for code administration, material specifications, welding control, and design of cylindrical shells are tabulated, and a critical assessment is made of the various codes in relation to their future development.

Engineering Considerations in Drilling From a Floating Vessel..61—SA-50...By R. F. Bauer, Global Marine Exploration Company, Los Angeles, Calif. 1961 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1962).

The art of drilling into submerged lands from a floating vessel is still relatively new. The technique has been used most extensively in petroleum exploration of the California offshore. There is, however, a growing interest in its use in other geographic areas, and in fact, in other industrial areas.

The author discusses briefly some of the engineering considerations pertinent to this type of operation. Included are discussions of the vessel to be used, the mooring of the vessel, and special drilling equipment.

Use of Hard Carbide Components in Petrochemical Procession..61—SA-51...By W. L. Kennicott, Mem. ASME, Kennametal Inc., Latrobe, Pa. 1961 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1962).

Traditionally, the tool materials of one period become the structural and wear materials of the next period in engineering design. This is particularly true in process industries, where improved materials make possible lower maintenance, higher operating efficiency, or even new processes not possible at lower combinations of temperature, pressure, flow rate, or volume.

The sintered hard carbides are such materials. In the 1930's and 1940's they became the most common tool materials for metal cutting; in the 1950's the most common cutting-tool materials for the drilling of mineral deposits and rock; and in the early 1960's are already becoming firmly established as materials for critical components of process industries.

Discussed are the unique properties of various sintered hard carbides, their advantages and limitations, design principles, and some specific applications in processing equipment used in the petroleum and petrochemical industries.

A New Look at Pressure Vessel Testing..61—SA-58...By C. E. Lautzenheiser and F. B. Crouch, Jr., Dow Chemical Company, Freeport, Texas. 1961 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1962).

Present-day practice in the design, construction, and maintenance procedures for pressure vessels and piping, coupled with periodic hydrostatic testing, was reviewed by the authors' company. Recent technological improvements in nondestructive testing were included; that is strain gage, brittle lacquer, magnetic particle, dye penetrant, radiographic, eddy current, and others. The review places emphasis on three primary methods of securing information: (*a*) Operating history, (*b*) visual inspection, and (*c*) wall-thickness measurements.

In summary, it is stated that there is no single test or combination of tests that will indicate the exact condition of a pressure vessel. However, this same condition of unknowns existed when the vessel was fabricated as it was not feasible

to determine the exact condition of all portions of the vessel material and weldments. A satisfactory determination of the condition of the vessel can be obtained through the use of operating history, wall thickness, and hydrostatic testing in conjunction with other nondestructive test methods. Continual periodic visual and wall-thickness measurement tests are necessary to determine any unknown changes in the corrosion rate.

It is concluded that testing programs of this type must be supervised by technical personnel well versed in the ASME Boiler and Pressure Vessel Code and thoroughly conversant with pressure vessel design and nondestructive testing techniques.

Fabrication Requirements for Balanced Classes of Piping..61—SA-60...By H. S. Peterson, Mem. ASME, and C. H. Voelker, The M. W. Kellogg Company, New York N. Y. 1961 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1962).

Piping, as compared with other pressure equipment, is only recently receiving attention in proportion to its significance in the process, power, and other industries. In process plants, piping may represent as much as 50 per cent of overall costs. Of this, the fabrication and erection of piping are of major consideration. Welding plays a major role in the present trend for minimizing flanged fittings and valves. Technological progress demands higher pressures and temperatures, increased service severity, and large-sized integrated process units, pipe of larger sizes, increased wall thicknesses, and sensitive alloy materials.

As a result, piping engineering is no longer predominantly dimensional, and is instead moving to full professional stature involving engineering capabilities in structural mechanics, metallurgy, fabrication, and inspection.

Requirements for a number of classes of piping construction are presented in summarized form to facilitate ready appreciation and comparisons, and are supplemented by detailed information with respect to the more significant requirements. The authors examine broadly the fabrication and inspection of schedule-size steel pipe (24-in. NPS and smaller), including forming and assembly by girth and branch welds into piping assemblies.

Working of Metals Via Explosives..61—Pet-3...By John S. Rinehart, Colorado School of Mines, Golden, Colo. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

The explosive working of metals has become commonplace during the past few years, with explosives being used extensively to compact metal powders and to work-harden, draw, form, swedge, and cut metals. These processes involve forces, situations, and concepts that are not ordinarily known by the average mechanical engineer.

Explosives working operations fall into three categories: (*a*) those in which a high explosive is detonated in intimate contact with the workpiece used in the hardening of steels, the compaction of metal powders, the splitting of ingots, and cutting operations; (*b*) those in which objects such as cups, rocket nozzles, missile noses, and aircraft parts are sized or formed by drawing, using high explosives detonated in air or in water at some distance from the workpiece; and (*c*) those in which a closed system is used, the operating pressure being generated by burning propellants (low explosives).

The scientific bases for these operations are discussed.

Industrial Utility Cycle Study Adapted to Linear Programming..61—Pet-4...By Thomas W. Stubblefield and Gordon C. McKeague, Standard Oil Company, Whiting, Ind. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

A growing steam and power-generating system serving a large refinery must be under nearly constant review to assure both adequate and economical service. Each change in existing load, each new increase in load on existing refinery units, and each new process unit includes the questions: Can steam and power be provided and at what cost in operating expense and investment? Answers to these questions are important factors in the economic justification of a change or addition to the refinery operation.

In order to provide engineers with a tool to solve these problems quickly, an electronic computer is used. The computer not only determines if the existing steam and power-generating facilities can meet the change in demand, but through the use of a system of equations and linear programming also determines the least cost way of doing so.

The authors describe how steam-power analysis may be adapted to computers for use in engineering. Complex systems, including numerous pieces of equipment and costs, are analyzed to determine the most economical selection of both new and existing equipment to meet any load. Total costs for alternate case studies and incremental costs for small changes in any variable are readily determined.

Strength of Thick-Walled Pressure Vessels for Materials With Directional Properties..61—Pet-1...By A. E. Dapprich, Assoc. Mem. ASME, Gannon College, Erie, Pa.; Joseph Marin, Mem. ASME, Pennsylvania State University, University, Park, Pa.; and Tu-Lung Weng, National Carbon Company, Parma, Ohio. 1961 ASME Petroleum Mechanical Engineering Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to July 1, 1962).

In problems concerned with the deformation of materials in the elastic and early plastic ranges, the magnitudes of the displacements encountered are small compared to the dimensions of the deformed element. For such problems it is sufficiently accurate to employ the infinitesimal strain concept wherein the deformations are referred to the original dimensions of the element rather than the instantaneous values. As the magnitude of the plastic deformation increases a condition is soon reached where an analysis of the state of stress and strain requires the application of the finite strain concept. Furthermore, in order to present a complete solution the directional properties of the material should be taken into account.

Such a situation is presented in the problem of finite plastic deformation of a thick-walled, closed-end stainless-steel pressure vessel subjected to internal pressure. In this theory, large or finite strains are considered and a closed solution is found for the pressure-strain relation based on a modified log-log tensile stress-strain relation. Theory also is developed for predicting the maximum pressure the vessel can withstand.

Strain Hardening in the Yielded Compound Cylinder..61—Pet-2...By S. J. Becker and H. Kraus, Assoc. Mem. ASME, Westinghouse Electric Corporation, Bettis Atomic Power Laboratory, Pittsburgh, Pa. 1961 ASME Petroleum Mechanical Engineering Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to July 1, 1962).

In previous investigations, the first named author has examined the general problem of the design of compound cylindrical pressure vessels. These studies were involved with the ideal design of compound cylinders (Trans. ASME, Series B., *J. Engng. for Indus.*, vol. 82, 1960, pp. 136–142), the analysis of yielded compound cylinders in plane strain (zero axial strain) (Trans. ASME, Series B., *J. Engng. for Indus.*, vol. 83, 1961, pp. 43–49), and the analysis of yielded compound cylinders in generalized plane strain (axial strain a function of load only), (ASME Paper No. 60—WA-71).

This investigation extends the earlier work to the analysis of yielded compound cylinders in generalized plane strain with a linear strain-hardening of the cylinder

material. The method, which is limited to small strains, uses a modified Tresca yield condition and assumes incompressibility for both the plastic and the elastic ranges.

Causes and Prevention of Decay of Wood in Cooling Towers..61—Pet-5... By R. H. Baechler, J. O. Blew, and Catherine G. Duncan, U. S. Department of Agriculture, Madison, Wis. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

The authors review studies made at the U. S. Forest Products Laboratory on one aspect of the deterioration of wood in cooling towers; namely, decay produced by various species of fungi and on treatments for the control of such deterioration.

The following conclusions appear justified by present knowledge.

1 The probability of early decay in cooling towers made of untreated redwood may be reduced greatly by maintaining a pH close to neutrality and avoiding chlorine concentrations above 1 ppm for protracted periods.

2 It appears to be good insurance to invest in wood treatment as part of the cost of constructing a new tower.

3 Enough evidence has been collected on the diffusion process, at least, to indicate that considerable benefit can be expected for fill members in the flooded parts of towers. The value of treatments, including the diffusion process, in arresting internal decay in the larger members present in both flooded and nonflooded areas is still uncertain. As a safeguard, towers built of untreated wood probably should be inspected at least once a year. When signs of wood deterioration appear, treatment of the tower probably will prove to be a good investment.

Vessel Nozzles and Piping Flexibility Analyses..61—Pet-7... By P. G. Stevens, Assoc. Mem. ASME, and R. B. Bell, American Oil Company, Whiting, Ind.; and V. J. Groth, Sperry Rand Corporation, Minneapolis, Minn. 1961 ASME Petroleum Mechanical Engineering Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to July 1, 1962).

It is seldom practicable or even possible for the engineer to solve completely and precisely any but the very simplest stress analysis problem. Instead, by the use of conservative simplifying assumptions he must convert the problem to be solved into a problem for which a solution is available. When this substitute problem has been solved, the engineer must then estimate how the results obtained should be adjusted to serve as a solution for the problem with which he was initially confronted.

Nowhere in the refining industry is this situation more disturbing than in the analysis of the thermal expansion and contraction of piping systems. Intermediate restraints, temperature variations along the main run and in branches, unknown erection strains, and even unknown fitting thicknesses plague the designer and force him into making simplifying assumptions.

Research work sponsored by the Pressure Vessel Research Committee of the Welding Research Council has made it possible to eliminate one of the major assumptions; namely, that vessel nozzles need to be considered as "fixed ends." This paper demonstrates that it is now practicable through the use of PVRC results to consider vessel nozzles as elastically restrained ends in a traditional piping flexibility analysis.

Automation in Orifice Fittings..61—Pet-6... By Herbert H. Hodgeman and Thomas J. Filban, Assoc. Mem. ASME, Daniel Orifice Fitting Company, Houston, Texas. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

The principle of orifice metering is well established. The authors deal with the need for, and the development and testing of, devices to extend the range and expand the usage of orifice metering through automation.

Discussed are (*a*) the duomatic orifice fitting, its construction, operation, instrumentation, and range, and (*b*) the multiplex orifice fitting, its design and applications.

Explosive Metal Forming Techniques..61—Pet-9... By V. H. Monteil, Rocketdyne, Division of North American Aviation, Inc., Canoga Park, Calif. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

Since most military aircraft and missiles are produced only in small quantities, a need has developed for the forming of many test parts in limited numbers. Explosive forming has evolved as one of the better known techniques to provide the required parts. The paper explains the types of explosive used, the requirements of forming by this means, the economics of explosive forming, and other aspects of the process.

The Effects of External Pressure on Thin-Shell Pressure Vessel Heads..61—Pet-10... By Edward O. Jones, Jr., Auburn University, Auburn, Ala. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

Effects of external pressure on thin-wall torispherical, toriconical, and ellipsoidal pressure vessel heads, including the determination of the collapse pressures, are discussed. Two test vessels, one having torispherical and 120-deg toriconical heads and the other having ellipsoidal and 90-deg toriconical heads, were used in the study.

Longitudinal and circumferential stresses per psi external pressure were plotted for the regimes at which the vessel heads had been welded to the cylindrical portions of the vessels. Deflection values were plotted for the torispherical and ellipsoidal heads. Both the stress values and deflection values were determined from experimental data.

Mechanical Refrigeration in Field Processing..61—Pet-11... By J. L. Horton, Mem. ASME, The J. B. Beaird Company, Inc., Shreveport, La. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

In recent years, a revival has occurred in the use of mechanical refrigeration in the plant-processing of natural gasoline. Now the same principles are being applied to field-processing, equipment being scaled down to meet the requirements of smaller plants.

Plants handling one-half to ten million feet per day are commonplace. The author explains how and why the present trend has occurred and gives the future prospects of mechanical refrigeration in the field.

Factors in Automating Engineering Graphics..61—Pet-12... By D. W. McArthur, Minnesota Mining and Manufacturing Company, St. Paul, Minn. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

There is a common language for automating engineering graphics. The components of this language are a reproducible medium plus an automated carrier.

The reproducible medium that converts all engineering drawings to both a uniform size and a uniform photographic quality is 35-mm microfilm. The automated carrier is a punch card.

Automated engineering graphics is a system having three inputs and three outputs. The inputs are microfilming, indexing, and mounting or film insertion into the cards; the outputs are distribution, reference, and reproduction. The proper approach to implementation is to work backward from the requirements of distribution, reference, and reproduction to the inputs of microfilming, indexing, and mounting.

The engineer must analyze three major factors before automating engineering graphics. He also must know how his company's products create conditions peculiar to his opera-

tions; and how to fit the inputs and outputs of automated engineering graphics to data use and operational requirements. Seven statistical and four interpretive questions are provided as guideposts for the engineer's inquiry.

Chemically Treating Cooling-Tower Lumber Protects Against Fungus Attack.. 61—Pet-8... By J. R. Goff and J. S. Excell, American Oil Company, Whiting, Ind. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

A discussion is given of the deterioration found in the Whiting Refinery cooling towers and of the factors leading to the selection of the double-diffusion method of treatment. Results of chemical retention in laths in test panels after six years exposure are summarized.

Towers can be protected against fungus attack if proper chemical treatment is applied. Furthermore, treating techniques are available to insure adequate retention throughout a tower. These protective salts do not leach out as fast as had been expected. On the assumption that as long as there is chemical retention, the wood is protected, the life of the treatment is still undetermined.

Automatic Control With The Plug Valve.. 61—Pet-13... By J. A. Pommersheim, Rockwell Mfg. Company, Norwalk, Ohio. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

The requirements for control valves have changed with the pipeline trends. Valve sizes up to 30 in. are being used and pressure drops must be small. Tight shut-off on all valve sizes and under practically every pressure condition has been demanded. Large sizes, higher pressures, noise, installation costs, ability to control, and the ability to adapt have caused the plug valve to assume importance as a control device.

An operational description of the plug-valve regulator is given as well as its advantages over the conventional style control valve. The regulator is divided into its major components and each is discussed in detail.

Also presented are the different constructions and assemblies for various controls such as pressure control, flow control, monitoring service, and back-pressure or relief application.

Programming a Liquid Pipeline Operation for Optimum Power Conservation.. 61—Pet-14... By Paul Pancio, Jr., Gulf Oil Corporation, Houston, Texas. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

The problem of minimizing the power cost for moving oil through an existing pipeline was subjected to numerous assumptions before the advent of the electronic computer. The use of a computer has permitted facts to replace assumptions. This paper presents variation of the techniques used to solve this problem.

The program is divided into three broad categories: Hydraulics, cost, and cost analysis. The first two, hydraulics and cost, are worked as a pair, so that once it has been determined a particular scheme of pumps can move a given maximum capacity, the cost of the movement is calculated.

After these calculations are completed, the cost analysis examines the data to determine which combinations of schemes will deliver the product at the lowest cost.

Rubber—An Engineering Material for the Petroleum Industry..61—Pet-15... By Dana R. Hall, Acushnet Process Company, New Bedford, Mass. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

Rubber—the types available, their properties, and uses in engineering applications—is discussed. Provided is an explanation of the basic qualifications essential for a correct interpretation of elastomeric properties.

Attention is given to the necessary steps a design engineer must take to develop a rubber product from idea to reality, with particular emphasis upon proper determination of requirements, design and material consideration, and product evaluation.

Study of Gas Engine Performance Leads to Oil Development..61—Pet-16... By E. W. Brennan, The Pure Oil Research Center, Crystal Lake, Ill.; and R. H. Moth, The Pure Oil Company, Palatine, Ill. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

Laboratory data for a variety of oils are presented along with theoretical consideration of oil composition in terms of base oils and additive treatment.

Several experimental oils were prepared, and along with the field-tested lubricants, were subjected to bench tests. Two types of tests were conducted: (*a*) an oxidation test wherein the oxygen absorption rate acid-number development was measured, and (*b*) a thermal degradation test (steel strip at 480 F) wherein the deposit tendencies of the oils were measured. These data are presented in bar graph from. Field test data accumulated in a variety of two and four-cycle gas engines are reviewed and evaluated.

Based upon the test data accumulated over a six-year period and the tens of thousands of operating hours, it is believed that the new gas-engine oil represents a substantial step forward in the lubrication of gas engines.

Automatic Station Control for Reciprocating Compressors..61—Pet-17... By A. C. Winter, Control Corporation, Minneapolis, Minn. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

Closed loop control for the natural gas pipeline system is becoming a reality.

Controls for reciprocating gas compressor stations and how they fit into the automatic pipeline system are described. Equipment requirements, characteristics, availability, and cost are discussed. Unattended compressor station operation is no longer anything new in the pipeline industry; however, control equipment installed should, in addition to providing for unattended type operation, also be compatible for alternate closed loop control from a single dispatch center. Greater emphasis must be placed on data collection and transmission and systems engineering becomes more important.

Selecting and Specifying Rubber for Petroleum Industry Use..61—Pet-18... By Roger C. Bascom, B. F. Goodrich Chemical Company, Cleveland, Ohio. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

The ability of rubber to seal against the transmission of air and fluids accounts for a great many of its applications in the petroleum industry. This paper deals particularly with the aspects of specifying and testing rubbers of many varied compositions and the characteristics that best suit them to particular applications.

Discussed are hardness testing, tension testing, tear tests, set tests, abrasion resistance, accelerated aging, low-temperature testing, ozone and dynamic testing.

Welding Processes for the Longitudinal Seam of Line Pipe..61—Pet-19... By Robert S. Ryan, Columbia Gas System, Service Corporation, Columbus, Ohio; and P. J. Rieppel, Battelle Memorial Institute, Columbus, Ohio. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

There are four major processes for producing welded pipe. Of these, three are in common use. These three are submerged-arc, flash welding, and low-frequency resistance welding. The fourth, high-frequency welding, is a newcomer to the field and is being used by just a few manufacturers at present.

The fundamental principle of each

process is described, as well as how it is used in making line pipe. Some of the advantages and disadvantages of each process are included.

Deformation of Drill Pipe Held in Rotary Slips..61—Pet-20...By T. Vreeland, Jr., California Institute of Technology, Pasadena, Calif. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

An analysis of measurements of drill-pipe deformation in the slip area is presented. Drill pipe was loaded in excess of the load at the minimum yield strength with the pipe in VARCO Type SDL and Type SDXL slips.

A VARCO Type MSS solid master bushing was used with the type SDL slips and the master bushing of a VARCO KMPC unit was used with the Type SDXL slips. Measurements were made on the reduction in pipe diameter in the slip area as a function of load. Values of load which caused inelastic deformation of the pipe are determined and compared to the values previously calculated from theory.

The test results show that 5-in., 19.5-lb/in. grade E drill pipe may be gripped in VARCO SDL and SDXL slips without producing excessive deformation at loads up to 500,000 lb. If slips or bushings are worn, a concentration of transverse loading can occur to increase deformation markedly. The greater back-up area of SDXL slips will maintain a more accurate taper under protracted use at high loads.

Least Cost Estimating and Scheduling..61—Pet-21...By F. Backer, Jr., A. W. Barkson, and M. C. Frishberg, International Business Machines Corporation, Los Angeles, Calif. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

Least cost estimating and scheduling is a recently developed technique that is of much interest to management. This technique attacks a class of problems that cut across all kinds of industries—construction firms, oil refineries, aircraft companies, chemical plants, insurance companies—all have received benefits from LESS. In all these industries and in hundreds of related and nonrelated activities, there exist similar opportunities to benefit from an application of this technique.

The authors discuss the technique in operation and the way in which management can take advantage of much current information.

For purposes of easy illustration, a simple maintenance and repair project—that of a vacuum pump—is used as an example.

Epoxy Resin as a Tool in Plant Maintenance..61—Pet-22...By R. H. Bacon, The Dow Chemical Company, Freeport, Texas. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

Epoxy resins have become a valuable tool in reducing maintenance cost due to corrosion. A description is given of the use of epoxy resins, liquid and solid. Relative costs and cautions in their use are discussed.

Typical jobs are described. A series of case histories is included, showing the many ways these versatile resins may be used successfully.

Case histories in the use of formulated solid epoxy resins are described, as well as some uses of liquid epoxy resins in the repair of product lines, in the lining of tanks and evaporators, and in jacket insulated towers.

Investigation of Sucker-Rod Pumping Performance..61—Pet-23...By Warren E. Snyder, Assoc. Mem. ASME, Midwest Research Institute, Kansas City, Mo. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

The installation, operation, and maintenance of oil-well pumping equipment are among the major costs of oil production. To reduce these costs, a group of about 30 oil-producing and well-equipment companies formed a corporation, Sucker Rod Pumping Research, Inc., to sponsor a study of pumping performance. This paper is a partial report on that research program.

The first phase of the research program was the development of a laboratory-scale model of a complete pumping system. This simulator was designed to reproduce all important well actions. The parts of the system were readily available for detailed measurements. Each of the many well variables could be altered and controlled at will.

The second phase of the program was a study that used the simulator to determine the influence of the well variables on performance. Particular emphasis was placed upon the forces imposed on the sucker rod and pumping unit, and upon the net well production.

The third phase, now nearing completion, is an analog-computer study of the system. It has been based heavily upon the results obtained from the simulator.

Mechanisms of Failure of Plastic Pipes in Plant Usage..61—Pet-24...By L. W. Gleekman, Wyandotte Chemicals Corporation, Wyandotte, Mich. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

A practical analysis of plastic-pipe failures is presented dealing both with thermoplastic and thermosetting materials, and with lined and unlined plastic pipes. Physical properties of plastics and other common constructional materials establish that plastics should not be installed "size for size" and "part for part" for previously used metal pipes.

Types of failures discussed are misalignment, overheating, improper supports, expansion, nonpressure stresses, chemical resistance, weathering, freezing, combustion, fatigue, weeping, and creep.

Application of Optical Equipment for Installing and Checking Large Machinery..61—Pet-26...By John Hanold, Keuffel and Esser Company, Hoboken, N. J. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

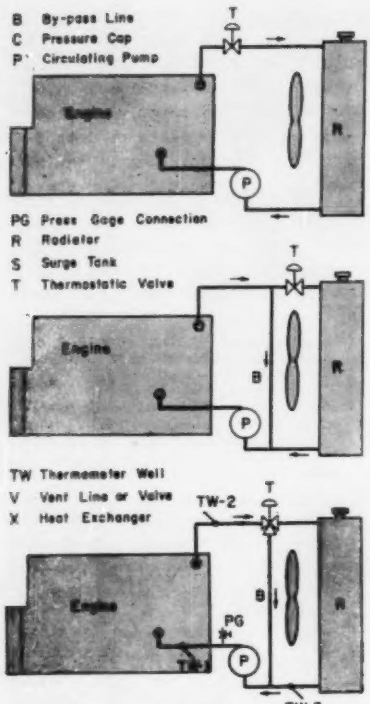
Although optical tooling was developed primarily for the airplane industry, its use has spread until today it is being used wherever precise alignment is required for the erection or maintenance of large machinery. This optical-alignment equipment is not a "cure-all," but, when properly used, it will provide faster alignment, more accurate alignment, or both. Where-ever better alignment is achieved, smoother operating machinery is found to result. This in turn, means less maintenance, and very often allows higher operating speeds.

Discussed are optical alignment and equipment used in the petroleum and allied industries for the following: (*a*) Leveling and checking machine movement under various load and temperature conditions; (*b*) initial alignment of large compressors and pumps; (*c*) bearing alignment; (*d*) shaft-coupling alignment.

Modern Centralized Dispatching of the Mid-America LPG System..61—Pet-28...By William F. Haley, Westinghouse Air Brake Company, Houston, Texas; and G. V. Rohleder, Mid-America Pipe Line Company, Tulsa, Okla. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

Liquid propane gas is used for cooking, water heating, refrigeration, clothes drying, space and central heating in homes and commercial establishments, fuel for tractors, trucks and buses, and as a standby fuel for various commercial and industrial concerns. The fuel can be mixed with air in central plants in small towns for distribution to home consumers.

A combination of new techniques developed for dispatching liquid pipelines from a central location is described. The items discussed are: Set point control, unit control, unit alarms, unit



Pinching-type thermostat control system, **top**, is used on high-speed multicylinder engines. Thermostatic element **T** pinches flow while radiator **R** maintains desired engine-jacket outlet temperature. To prevent thermostat from throttling flow below given minimum, fixed bypass lines are installed, **center**. Best method of engine jacket-water temperature control, **bottom**, employs temperature-controlled three-way valve. (61—Pet-32).

and station, sequence equipment, telemetering, product in-out metering, PD meter preset deliveries, and terminal facilities.

Use of Positive Displacement Meters to Develop Tank Tables..61—Pet-29... By Ray H. Pfrehm, Humble Pipe Line Company, Houston, Texas. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

Probably the most common cause of inaccuracy in tank tables is the deposit of wax or paraffin which accumulates on the inside of tank walls.

In order to determine accurately the volume in a tank, Humble Pipe Line Company has developed a system using a positive-displacement meter which prints out incremental tank volumes with changes in liquid level. The unit is fully self-contained and portable. These incremental volumes are tabulated in such manner that they become a "tank table."

Although the portable tank strapper described was designed primarily to check lease tankage, the principle is adaptable to tanks of any size and shape. Large tanks can be calibrated simply by using the equipment discussed here on meters large enough to measure accurately the fill or withdrawal from the tank.

Application of Energy Principles for Finding Critical Hook Loads in Drill Pipe.. 61—Pet-30... By Donald W. Dareing, Jersey Production Research Center, Tulsa, Okla. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1961).

Failures in drill pipe due to "necking down" sometimes occur in the area where the slips hold the pipe in the rotary table. These failures are due to the combination of the crushing of the pipe by the slips and tension on the pipe from the suspended load (hook load) beneath the rotary table.

High stresses exist which may cause localized yielding of the pipe. The casing-suspension problem is closely related to the drill pipe-suspension problem. In addition to localized yielding, which may lead to failure of the casing, any decrease in diameter of the casing while clamped in the slips may also be critical because tools must ultimately be lowered through the completed casing string. The assumption of a uniform pressure distribution between the slips and drill pipe or casing appears to be questionable. The purpose of this paper is to present an energy approach in which a nonuniform pressure distribution is assumed.

Planning and Forecasting Steam-Electric Requirements for a Large Refinery.. 61—Pet-31... By William B. Thomas, Mem. ASME, and C. H. Griffenberg, Jr., Texaco Inc., Port Arthur, Texas. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

In 1953 Texaco was faced with the need for an appreciable increase in the steam and electric generating facilities at the company's largest refinery at Port Arthur, Texas.

Prior to this expansion the plant had kept the usual accounting records of steam and electric generation and usage. During the investigation to determine the size of steam and power facilities required, a great deal of effort was given to assembling this information in the most usable form.

A system was developed for this purpose and, after the project was completed, the information was kept current. With this system, it is now possible to advise top management in a matter of hours what, if any, steam and electric generating facilities will be required for any proposed processing unit or combination of units. Also, the optimum division between steam-turbine and electric-motor drives can be determined quickly.

Design of Engine Jacket Water-Cooling Systems That Use Circulating Pumps.. 61—Pet-32... By Duane E. Marquis, Assoc. Mem. ASME, Phillips Petroleum Company, Bartlesville, Okla. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

A design outline is presented for a field-proved internal-combustion-engine cooling system. The cooling system described maintains at all times full coolant flow through the engine jacket. It provides excellent control of engine temperatures under all conditions of varying engine loads and heat-exchanger capacity. It is straightforward in design and void in involved computation.

Some engines in operation today would require but slight modification to conform completely to the system discussed. Others would require the purchase of the three-way valve and a more complete conversion. Assurance is given that future engine-maintenance savings would justify such modifications.

Development of 5500 bhp Compressor Engine With En Bloc Compressor Cylinders..61—Pet-33... By F. M. McNall and J. J. Murphy, Clark Brothers Company, Olean, N. Y. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

As the throughput of natural gas pipeline has increased in recent years, economic considerations have consistently favored the installation of larger engine-compressor units. The installation of the largest unit suited to the operating needs of a particular transmission requirement results in substantial savings in installation and operating costs. This fact has been well substantiated by actual installations.

To meet this requirement and to better match available engine size of today's pipeline requirements, the authors' company has recently developed a 5500-bhp turbocharged, two-cycle, integral engine-compressor unit. This paper gives details of the engine and the results of its 3000 hr of operation.

The Special Equipment and Problems Associated With Large Diameter Rotary Drilling..61—Pet-34... By James H. Allen, Hugh B. Williams Mfg. Company, Dallas, Texas. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

The special equipment and problems associated with the rotary drilling of holes larger than 30 in. diam. are described and the history and usages of large-diameter holes are reviewed. The paper also covers the operation dif-

ficulties when drilling with conventional rotary equipment, the special equipment required for efficient and economical completions, and the potential or future for large-diameter drilling.

Clearly Defined Ideals..61—Pet-35... By Thomas B. Foster, The Emerson Consultants, Inc., New York, N. Y. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

The vagueness, the uncertainty, the aimlessness that characterize employees is but an infiltration of the vagueness, uncertainty, and aimlessness that characterize managers. If every manager would formulate his own ideals, promulgate them throughout his company or plant, post them everywhere, inoculate every manager and every employee with them, industrial organizations could attain the same high degree of individual and aggregate excellence as a professional football team.

Columbium-Treated Pipeline Steels..61—Pet-36... By Clarence L. Altenburger, Great Lakes Steel Corporation, Detroit, Mich. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

When small quantities of columbium are introduced in mild-carbon steels, the tensile yield and ultimate strength are greatly increased with little sacrifice in elongation or reduction of area. In thicknesses used in gas-transmission pipe, notch toughness is improved and the weldability of mild steel is preserved.

These properties are attainable in semiskilled steels so that an economical, strong, tough, and weldable steel is produced. Substantial tonnage has demonstrated that coils or cut lengths can be fabricated into pipe without difficulty, and that this pipe can be installed in the field without trouble.

Factors Involved in Supplying Electric Service to Pipeline Pump Stations..61—Pet-27... By Tom V. Grayson, West Texas Utilities Company, Abilene, Texas. 1961 ASME Petroleum Mechanical Engineering Conference paper (multilithographed; available to July 1, 1962).

The author explains factors involved in supplying service to pipeline pump-station loads. To this end a simplified hypothetical electric utility is used to develop the procedure. This utility conforms to the realistic conditions of investment and operating expenses of an actual company of the same magnitude.

From the analysis, it is determined that the per cent return under normally expected operating conditions would be adequate to justify the utility's investment and incurred operating expenses necessary to serve this load.

Automatic Control

The Structure of Optimum Control Systems..61—JAC-1... By Bernard Friedland, Columbia University, New York, N. Y. 1961 Joint Automatic Control Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to April 1, 1962).

A large class of optimum control problems can be formulated as the variational problem of minimizing a known functional subject to isoperimetric and nonholonomic constraints. The (vector) Euler equation for this problem leads directly to the structure of the optimum controller, which turns out to comprise a dynamic portion that is the adjoint of the plant to be controlled and instantaneous nonlinear elements determined by the performance functional and input constraints. Continuous measurement of the state of the plant results in the elimination of the dynamic portion, and the entire optimum controller is instantaneous.

An example illustrates the complete design of regulators for a simple plant with constraints on either amplitude or energy of the actuating signal that minimizes response time or integrated square error.

On the Existence of Optimal Controls..61—JAC-2... By L. Markus, University of Minnesota, Minneapolis, Minn.; and E. B. Lee, Assoc. Mem. ASME, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn. 1961 Joint Automatic Control Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to April 1, 1962).

The problem of existence of various types of optimum controls for controlling processes described by ordinary differential equation models is considered.

It is shown that if the set of allowable controls that does the prescribed task is nonempty then, under rather general conditions, there will exist an optimum control in the allowable set that accomplishes the prescribed task. The authors show that if the set of allowable controls is a compact convex body to which the null control belongs, then each initial condition of the variables $x^i(t)$ in some neighborhood of the origin can be transferred to the origin in a finite time interval by means of a control from the allowable set providing the differential equation system satisfies a certain condition at the origin.

It is also shown that if the differential equation system is globally asymptotically stable to a point O, then under certain restrictions on the differential equation system and the set of allowable controls, there will exist one control which transfers any initial conditions x_0^1 to the origin O in a finite time interval. The regions for which there exist an optimal control for particular second-order differential equations is found using certain constructions in the plane.

Time Optimal Control of Nonlinear Processes..61—JAC-3... By E. Bruce Lee, Assoc. Mem. ASME, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn. 1961 Joint Automatic Control Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to April 1, 1962).

A number of problems connected with the time optimum control of processes described by means of nonlinear differential equations are considered. It is shown that in quite general situations if there exists a time optimal control, there exists a time optimum relay (bang-bang) control. The question of the existence of time optimum controls is considered.

The nonlinear second-order process-equation is studied to provide a means for obtaining the time optimum control. A number of qualitative results are obtained which aid in finding an approximation to time optimum control for the higher order process-equations.

On the Periodic Modes of Oscillation in Pulse-Width-Modulated Feedback Systems..61—JAC-4... By E. I. Jury and T. Nishimura, University of California, Berkeley, Calif. 1961 Joint Automatic Control Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.**; available to April 1, 1962).

A general procedure for obtaining information on the periodic modes of oscillation in PWM and nonlinear sampled-data feedback systems is considered in this paper. Based on the equivalence of PWM in the state of limit cycles to the finite pulsed systems with the periodically varying sampling pattern, the methods of analysis applied to the latter are extended to obtain these limit cycles. In particular, the final value theorem is applied to obtain the fundamental response equation which gives rise to the limit cycles for the various specified modes. The theory is applied to systems with and without integrator and the results are checked by the phase-plane approach.

Two kinds of nonlinearities, namely pulse-width modulation and saturating gain, are discussed among the various nonlinearities, and examples are presented for each of these cases. Furthermore, both self-excited and forced oscillations are examined as well as the possible

existence of limit cycles for certain specified modes.

This approach to examining the periodic modes is not restricted to the type of nonlinearity or the order of the system and thus can be applied to various forms of nonlinear discrete systems. However, it is based on the assumption that the mode of the limit cycle is specified, as can be done in certain cases, and thus the method of this paper permits the study of the conditions that sustain those oscillations.

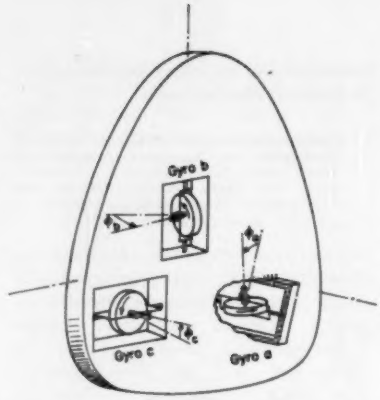
Stability of a Nonlinear Feedback System in the Presence of Gaussian Noise..61—JAC-5... By Rangasami Sridhar and Rufus Oldenburger, Mem. ASME, Purdue University, Lafayette, Ind. 1961 Joint Automatic Control Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to April 1, 1962).

A stability criterion for certain types of nonlinear feedback systems in the presence of Gaussian noise is established. This criterion may be considered as a natural extension of the describing function method. It is assumed that the lowest frequency component in the power spectral density of the noise is at least ten times higher than the highest significant frequency of the system. The method developed is applicable to feedback systems with just one instantaneous, nonmemory type nonlinearity in the loop. The results mentioned in this paper have been experimentally verified on an analog computer. The theory may be used by the designer to predict the manner in which noise will affect the performance of a system.

Optimal Control Methods for On-Off Sampling Systems..61—JAC-6... By W. L. Nelson, Bell Telephone Laboratories, Whippany, N. J. 1961 Joint Automatic Control Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to April 1, 1962).

This paper considers the problem of optimal (minimum-time) on-off regulation of a dynamic plant whose state is known only at periodic instants of time. It is shown that on-off control inputs that change value only at the sampling instants lack the capability of providing accurate (dead-beat) control.

If, however, the on-off controller is modified to include pulse-width control, it not only has the capability for accurate control, but also has the capability for optimal control comparable to that of a saturating amplifier controller. In addition, the optimal pulse width control inputs can be specified as a function of the state of the plant at each sampling instant. The application of this method is discussed in detail for the cases of pure inertial and second-order underdamped plants.



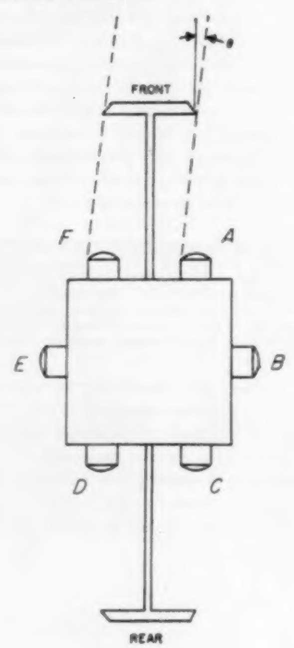
Movable single-axis gyros are used as actuators to control space vehicle attitudes. They require less power than reaction wheels because they spin at a constant high speed rather than by varying the speed of the rotor in a fixed axis reaction wheel (61—JAC-8).

Minimum Time Control of Second-Order Pulse-Width-Modulated Sampled-Data Systems..61—JAC-7... By E. Polak, University of California, Berkeley, Calif. 1961 Joint Automatic Control Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to April 1, 1962).

This paper treats the minimal time-control problem for two second-order, pulse-width-modulated, sampled-data systems, one with a double integrator type plant and one with a plant described by an integral and a time constant. Such plants are encountered in systems with hydraulic components.

It is shown rigorously that for minimal time control the phase plan can be divided into two regions: (*a*) a striplike region around the optimal switching trajectory for a continuous relay system with the same plants, in which the pulse width must be adjusted for optimal action and (*b*) the rest of the phase plane in which an optimal p.w.m. system of the type described behaves like a continuous optimal relay system, the pulse duration being equal to the sampling period. A brief description of an electromechanical computer capable of implementing minimal time control for the systems is given.

A sun-sensor for a space craft. Photoconductive detectors such as **A** and **F** are differentially shaded by a shadow vane that results in a high sensitivity region at the null point (61—JAC-9).



Gyroscopic Coupling in Space Vehicle Attitude Control Systems..61—JAC-8... By Robert H. Cannon, Jr., Stanford University, Stanford, Calif. 1961 Joint Automatic Control Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to April 1, 1962).

The problem of controlling the attitude of a space vehicle is unusual in several respects. While the required precision may be extreme—less than 0.1 second of arc in certain cases—the required response time may often be very slow, measured in minutes or hours. Vehicles weighing tons may have to be controlled by inch-ounces of torque, and control energy is at an extreme premium.

The paper discusses the effects, on performance, of interaxis coupling due to internal spinning parts. A decoupling computer to nullify gyroscopic torque is described, and its utility is evaluated. The computer is found to improve precision, but to reduce energy consumption only in certain cases.

It is shown that by postulating such a computer the performance of a given system may be accurately evaluated on the basis of much simpler single-axis relations, even though strong coupling is present. Specifically, it is shown that the best available performance is established by postulating decoupling control. A method is given for determining the amount by which a conventional system will fail to achieve that performance.

Derived-Rate Increment Stabilization: Its Application to the Attitude Control Problem..61—JAC-9... By J. C. Nicklas, Assoc. Mem. ASME, and H. C. Vivian, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, Calif. 1961 Joint Automatic Control Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to April 1, 1962).

A gyro-free nonlinear attitude control system for a spacecraft is analyzed. On-off jet actuators are used. Hysteresis and a dead zone are intentionally put into the system. Under certain conditions the feedback signal in the control system is proportional to an angular velocity increment of the system. This

is called the derived-rate increment feedback signal.

The analysis for a single axis of the attitude control system is given in two parts. One part is concerned with the performance of the system in a limit cycle. The other part discusses the convergence to a limit cycle after a disturbance has occurred. Experimental results verify the results of the analysis. Typical results show the performance of the system during convergence to and operation in a limit cycle. Although the technique is described for use in an attitude control system, it can be successfully employed in other applications.

A Successive Approximation Technique for Optimal Control Systems Subject to Input Saturation..61—JAC-10... By Yu-Chi Ho, Harvard University, Cambridge, Mass. 1961 Joint Automatic Control Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to April 1, 1962).

A first step to the complete optimal feedback control of a dynamic system is the determination of the appropriate control inputs to be applied to a dynamic system given a set of initial conditions such that the resultant behavior of the system is optimal in some sense. This is basically a calculus of variation problem. Solution to it in the general case is by no means simple, and, so far, only limited classes of this problem have been solved in closed form.

Restricting himself to a linear system subject to saturation only, the author presents a successive approximation method of solving optimal control problems associated with this class of systems. The particular problems solved are the quadratic error control problem and the time-optimal control problem. The technique has considerable advantages as a practical method of computing optimal solutions.

Optimal Pursuit Strategies in Discrete-State Probabilistic Systems..61—JAC-11... By J. H. Eaton and L. A. Zadeh, University of California, Berkeley, Calif. 1961 Joint Automatic Control Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to April 1, 1962).

One of the basic problems in control theory is that of finding an input that would take a given system from a specified initial state to a specified terminal state in minimum time or, more generally, at minimum cost.

In the case of discrete-state systems one can formulate and solve problems of considerable complexity—such as the interception of a randomly changing state in a system in which the transitions from one state to another are probabilistic rather than deterministic in nature. A problem of this type is treated in the present paper.

More specifically, the authors are concerned with the determination of an optimal interception strategy for the case where the motion of the target state is governed by a Markoff process and the transition probabilities of the system are controlled by the input. Actually, this problem can readily be reduced to the simpler problem of reaching a fixed specified state from a given initial state at minimum expected cost. As will be shown later, once this restricted problem is solved, it is a simple matter to extend its solution to the case of a moving target state. For this reason, much of the analysis deals with the problem of reaching a fixed rather than a moving state.

A Switching Criterion for Certain Time-Optimal Regulating Systems..61—JAC-12... By E. R. Rang, Assoc. Mem. ASME, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn. 1961 Joint Automatic Control Conference paper (in type to be published in **Trans. ASME—J. Basic Engng.;** available to April 1, 1962).

A rule for computing the initial relay position for time-optimal regulation corresponding to any set of initial conditions without solving the transcendental switching equations is presented.

The discussion is restricted to systems represented by ordinary differential equations with constant coefficients with real characteristic roots.

The calculation requires the evaluation of an $(n-1)$-order surface integral and cannot be considered a practical solution of the problem.

The discussion demonstrates that there are ways of deciding which initial relay position will give time-optimal response for each set of initial conditions without explicitly solving the transcendental switching equations. The result presented is not a practical solution in its present development.

Optimizing Control of Single Input Extremum Systems..61—JAC-13... By John S. Frait, University of Michigan, Ann Arbor, Mich.; and Donald P. Eckman, Case Institute of Technology, Cleveland, Ohio. 1961 Joint Automatic Control Conference paper (in type; to be published in **Trans. ASME—J. Basic Engng.;** available to April 1, 1962).

The idea of direct optimization is briefly presented and an introduction given to the divider-optimizer.

By investigation of the operating principles of the divider-optimizer, it is shown that the divider functions can be accomplished in separate and distinct manners. The optimizing behavior of the modified form of the divider-optimizer is investigated in the optimization of two different dynamic optimal systems. Experimental results of an analog computer study are presented.

It is also shown that the modified form of the optimizer presents the possibility of a more flexible optimizing control using simple, reliable, and relatively inexpensive components.

Production Engineering

Forming, Trimming, and Edge Finishing of Molybdenum-0.5 Per Cent Ti Sheet Material..61—SA-6... By A. L. Pickrell, Boeing Airplane Company, Seattle, Wash. 1961 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to April 1, 1962).

A summary is given of recent manufacturing experience with molybdenum-0.5 per cent Ti sheet material. This refractory metal is new to industry, it is needed for high-temperature vehicle application, and its fabrication characteristics differ significantly from other common airframe metals.

The paper presents manufacturing development test data and production experience from forming, trimming, and edge finishing of moly-0.5 per cent Ti material. It describes techniques, equipment, and procedures for "hot" forming moly-0.5 Ti. It provides recommendations for trimming moly and it suggests suitable methods for edge finishing production parts.

Machinability of Nodular Cast Irons, Part II; Effect of Cutting Conditions on Flank Adhesion..61—SA-7... By K. Hitomi, Mem. ASME, and G. L. Thuering, The Pennsylvania State University, University Park, Pa. 1961 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.;** available to April 1, 1962).

To determine the effects of cutting conditions on flank adhesion, nodular cast iron grade 60 was machined dry and wet carbide cutting tools K6, cast iron cutting grade, and K4H, steel cutting grade. Decreasing the feed rate raised the critical cutting speed at which flank build-up occurred and lowered the resultant tool force. For tools with positive rake angle, the critical cutting speed was generally higher and tool forces were lower than for tools with negative rake angle. A clearance angle of 15 deg eliminated flank adhesion, as did the use of cutting fluids. Flank build-up was analyzed chemically and metallurgically. Methods to prevent flank adhesion are recommended.

Management

Management of Research and Development Personnel in an Industrial Laboratory..61—Mgt-1...By R. B. Mears, United States Steel Corporation, Pittsburgh, Pa. 1961 ASME-AIEE-AIIE Engineering Management Conference paper (multilithographed; available to July 1, 1962).

Innumerable methods of managing research and development personnel have been proposed or actually tried out. These range from laissez faire methods, where the manager provides money, space, and equipment and encourages the research workers to attack any problem that interests them, to highly formalized and rigid control of the aims and even the actions of the research workers. Under specific conditions any of these approaches can yield valuable results.

Finding the optimum method of management under any one set of conditions is the big problem. Suggestions are made by the author for attaining this objective.

Transformation and Value..61—Mgt-2...By F. F. Bradshaw, consultant Croton-on-Hudson, N. Y. 1961 ASME-AIEE-AIIE Engineering Management Conference paper (multilithographed; available to July 1, 1962).

This paper reviews the progress of society, stressing the growth of such concepts as freedom of the individual, the right to exclusive ownership of property, and the application of science to solving the problems of everyday living.

It then points out that in the present struggle between the West and communism we seem to have forgotten that our tradition is on the side of aggressive action in favor of human liberty, not on the side of any "hold the line" policy of containment. The responsibilities of the engineer as a citizen are then discussed. The point is made that the engineer must mature in philosophy and in an understanding of his own culture, in order that he may take his place in the discussions which shape his environment.

The paper closes with the observation that the engineer should apply his logical approach to the social problems of the day, and should become more acquainted with the ideas of men, and the process by which these are formed.

Increased Profits Through Applications of Computer Technology..61—Mgt-3...By William W. Eaton, C-E-I-R, Inc., Arlington, Va. 1961 ASME-AIEE-AIIE Engineering Management Conference paper (multilithographed; available to July 1, 1962).

The extremely rapid advances in the whole branch of science known as computer technology have given the business manager powerful new tools for increasing profits, either through direct cost reductions or through higher efficiency, better management, and improved product quality.

Through the scientific developments in data processing "hardware," and corresponding advances in computer programming and analytical methods, or "software," it has become possible to successfully undertake problems in every facet of business operation, management, and decision making. Several specific examples are given that illustrate the kinds of business and management problems that can now be solved economically by special techniques such as linear programming, operations research, mathematical model building, computer simulations, and so on.

These methods, although understood in theory in the past, have been capable of only meager application to business management. They have recently come into practical usefulness in terms of dollars and cents.

Managing for Creativity in Engineers..61—Mgt-4...By H. C. Vernon, E. I. du Pont de Nemours & Company, Wilmington, Del. 1961 ASME-AIEE-AIIE Engineering Management Conference paper (multilithographed; available to July 1, 1962).

A model to show interactions of the elements of the organization coupled with analysis of the corporate values and individual competences, can assist management judgment.

Discussed are the functions of corporate management, selection of laboratory personnel, personality considerations, communication between engineers and management, freedom for engineers, and the appreciation of diverse talents.

Four rules of managing for creativity presented by the author in a previous talk are repeated.

Machine Design

Zero-Shift in Galvanometers Subjected to Mechanical Vibration..61—SA-55...By D. A. Conrad, Assoc. Mem. ASME, and D. G. Shellhorn, Hughes Aircraft Company, Tucson, Ariz. 1961 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1962).

Zero-shift is a phenomenon that may be exhibited by instruments containing a pendulum as a component and vibrated in a direction perpendicular to the axis of the pendulum. Under vibration the expected static equilibrium position of such instruments may become unstable resulting in a drift to an adjoining position of stable equilibrium.

The present study is a result of shifts having been observed in tests of unbalanced suspension-type galvanometers intended for use under the severe vibration conditions encountered in aircraft and missiles. It is shown that the three coupled nonlinear equations of motion can be reduced to a form similar to those studied by previous authors, but with the addition of strong damping torques and periodic variation of the torsional spring constant. Mention is also made of analog computer results, which confirm the theory, and of tests that provide qualitative correlation sufficient to establish that the mechanism studied here is the cause of the observed zero-shift.

Constant Diameter Cams, Their Properties and Design Characteristics..61—SA-2...By Karl Brunell, Bell and Howell Company, Lincolnwood, Ill. 1961 ASME Summer Annual Meeting paper (in type; to be published in Trans. ASME—J. Engng. for Indus.; available to April 1, 1962).

The constant diameter cam has long been used in shuttle-type motion picture and sewing machine mechanisms. Such cams are, regardless of their angular position, always tangent to two parallel abutments a fixed distance apart. Thus captured between two opposed sides of the follower, the return spring for the follower is eliminated and the cam load is greatly reduced.

Despite this great advantage, the application of constant diameter cams in high-speed mechanism has had some serious drawbacks. It is well known that for good dynamic performance at least the velocity and acceleration of the follower must be zero at the start and end of the cam action. Designers, however, have always composed constant diameter cams out of circular arcs and these, when combined with a dwell period, can inherently never satisfy the desirable high-speed characteristics mentioned. Any attempt to compose such cams from more desirable curves has met with failure and even for the ordinary, spring returned, flat faced follower the choice of cam curves is limited.

Some basic properties that govern the design of constant diameter cams and open cams with flat faced translating followers are developed. It is shown that the radius of cam curvature is the governing criterion and its proper use makes possible the design of constant diameter cams for any desired dynamic characteristic.

Surface Durability Ratings of Spiroid Gears..61—SA-1...By Woodrow D. Nelson, Illinois Tool Works, Chicago, Ill. 1961 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1962).

A spiroid gear system is characterized

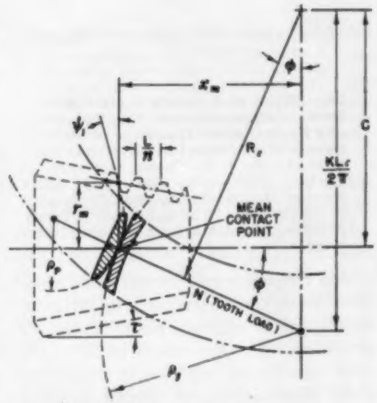
by having a conical-shaped pinion engaged with a face-type gear operating on skewed-axes. The pinion threads are of constant lead and have unsymmetrical pressure angles. The gear teeth are spiral in form and are always generated conjugate to the mating pinion threads.

Spiroid, a recent innovation in the art of medium to high-ratio reduction gearing, has found many areas of usefulness in the fields of power and motion transmission. With the emergence of this new skew-axis gearing concept came the problem of determining reliable gear set ratings.

The surface-durability rating of high-slide/roll ratio gears such as worm, spiroid, and hypoid, is dependent to a large degree on the proper choice of mating materials and lubrication. It is calculated for a specific combination of materials and lubricants and not for each member separately. The calculations of these ratings based on actual test data, are presented.

Maximum Stresses in Beams and Plates Vibrating at Resonance..61—SA-14... By Eric E. Ungar, Assoc. Mem. ASME, Bolt Beranek and Newman, Inc., Cambridge, Mass. 1961 ASME Summer Annual Meeting paper (in type; to be published in Trans. ASME—J. Engng. for Indus.; available to April 1, 1962).

Expressions are derived that relate the maximum stresses encountered in simply supported beams and rectangular plates and in clamped circular plates vibrating at resonance to modal displacements and modal loadings. Computation of modal loadings from time-wise harmonic or random pressures is discussed. It is shown that the resonant maximum stress may be reasonably approximated by a simple formula suitable for conservative design calculations for all types of beams and plates.



Geometric relations for durability calculations of high-slide/roll ratio gears such as worm, spiroid, and hypoid gears (61—SA-1)

Applied Mechanics

The Elastic, Plastic Bending of a Simply Supported Plate..61—APM-18...By G. Eason, King's College, Newcastle upon Tyne, England. 1961 ASME Applied Mechanics Summer Conference paper (in type; to be published in Trans. ASME—J. Appl. Mech.; available to April 1, 1962).

The problem of the elastic, plastic bending of a circular plate, simply supported at its edge and carrying a constant load over a central circular area, is considered. The von Mises yield condition and the associated flow rule are assumed and the material of the plate is assumed to be nonhardening, elastic, perfectly plastic, and compressible. Stress fields are obtained in all cases and a velocity field is presented for the case of point loading. Some numerical results are given comparing the results obtained here with those obtained when the Tresca yield condition is assumed.

In conclusion, it is found that the stress distribution for a given problem is relatively insensitive to the yield condition. The volume of a given body which is plastic for a given load is likely to be much more sensitive to the choice of yield condition. In the problem considered here the uniformly loaded plate is much more sensitive to change of yield condition than the plate subjected to point loading.

Combined Stresses in an Orthotropic Plate Having a Finite Crack..61—APM-19...By D. D. Ang and M. L. Williams, California Institute of Technology, Pasadena, Calif. 1961 ASME Applied Mechanics Summer Conference paper (in type; to be published in Trans. ASME—J. Appl. Mech.; available to April 1, 1962).

Using a formulation in integral equations, a solution for the combined extension-classical bending stress and displacement solution is presented for the case of an infinite orthotropic flat plate containing a finite crack. While the solution can be expressed in closed form for the entire field, primary emphasis is placed upon the stresses near the crack point.

Qualitatively, no major difference in behavior due to orthotropy was found although certain quantitative features are noted, mainly as a function of the characteristic rigidity ratio $(E_x/E_y)^{1/2}$. The inverse square-root character of the isotropic stress bending and extension is not changed by orthotropy, although amplitudes and distribution are affected. Account is taken of recent important work by Knowles and Wang dealing with Reissner bending of the plate which shows that the extensional and surface bending stresses are identical in singular character and circumferential distribution. A bending-extension interaction curve for fracture initiation is derived and shown to be linear when based upon the more exact bending theory.

Plastic - Stress - Strain Relationships—Further Experiments on the Effect of Loading History..61—APM-24...By J. Parker and J. Kettlewell, University of Manchester, Manchester, England. 1961 ASME Applied Mechanics Summer Conference paper (in type; to be published in Trans. ASME—J. Appl. Mech.; available to April 1, 1962).

Further tests have been carried out on thin closed-ended tubes of alpha brass subjected to various combinations of torque and internal pressure. The effect of loading, unloading, and reloading along different paths has been investigated. The loading paths were based on a yield function that has previously been found to correlate initial radial loadings for this material, which possesses one degree of anisotropy. Howeven, the results obtained from the second loadings suggest a cross effect which is greater than would be obtained from a nested set of yield surfaces of the foregoing form. There appears to be no evidence to support the presence of a corner in the yield surface.

Diffraction of a Pressure Wave by a Cylindrical Cavity in an Elastic Medium..61—APM-26...By M. L. Baron, Mem. ASME, and A. T. Matthews, Paul Weidlinger, Consulting Engineer, New York, N. Y. 1961 ASME Applied Mechanics Summer Conference paper (in type; to be published in Trans. ASME—J. Appl. Mech.; available to April 1, 1962).

An infinitely long cylindrical cavity in an infinite elastic homogeneous and isotropic medium is enveloped by a plane shock wave whose front is parallel to the axis of the cavity. An integral transform technique is used to determine the stress field produced in the medium by the diffraction of the incoming shock wave by the cavity. Expressions for the radial stress σ_{rr}, the hoop stress $\sigma_{\theta\theta}$, and the shear stress $\sigma_{r\theta}$ are derived as inversion integrals, and numerical results are presented for the time-history of the hoop stress $\sigma_{\theta\theta}$ at the boundary of the cavity. The amplifications of the hoop-stress concentration factors due to the dynamic loading are noted.

The problem is considered for pressure waves with a step distribution in time. These results may be used as influence coefficients to determine, by means of Duhamel integrals, the stress field pro-

duced by waves with time-varying pressures.

The Effect of Rotatory Inertia and of Shear Deformation on the Frequency and Normal Mode Equations of Uniform Beams With Simple End Conditions..61—APM-25... By T. C. Huang, University of Florida, Gainesville, Fla. 1961 ASME Applied Mechanics Summer Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to April 1, 1962).

New frequency and normal mode equations for flexural vibrations of six common types of simple, finite beams are presented. The derivation includes the effect of rotatory inertia and transverse-shear deformation. A specific example is given.

The novel features are (*a*) the solutions are obtained for two complete differential equations in total deflection and bending slope, respectively, (*b*) the constants in these solutions are related by any one of the two original coupled equations from which the foregoing two complete differential equations are derived, and (*c*) the boundary conditions prescribed are homogeneous.

An Addition to the Theory of Whirling..61—APMW-1... By T. R. Kane, Mem. ASME, Stanford University, Stanford, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

Particular solutions of the equations of motion of a heavy disk attached at the center of a light, vertical, elastic shaft are used to describe a variety of forms of whirling. The stability of these motions is analyzed by a perturbation method.

This leads to results that are more diverse and display better agreement with observed motions than might be expected in view of the simplicity of the underlying assumptions. The paper has a twofold purpose: To give detailed descriptions of certain whirling motions and to establish possible points of departure for further study of others.

Natural Frequencies of Vibration of Fixed-Fixed Sandwich Beams..61—APMW-2... By M. E. Raville, En-Shiuh Ueng, and Ming-Min Lei, Kansas State University, Manhattan, Kan. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

The natural frequencies of vibration of a fixed-fixed sandwich beam are determined by an energy approach in which the Lagrangian multiplier method is utilized to satisfy the boundary conditions. The same method can be applied to the analysis of vibration problems of sandwich beams with other combinations of end conditions and can be extended to the analysis of sandwich plates. The analysis is carried out according to the following assumptions:

1 The facings of the sandwich are homogeneous, isotropic, and elastic thin plates of equal or unequal thickness.

2 The core consists of an elastic, orthotropic continuum whose load-carrying capacity in the plane of the sandwich is negligible.

3 The modulus of elasticity of the core in the direction perpendicular to the facings is infinite.

4 Perfect continuity exists at the interfaces.

Experimental results are given for 21 sandwich beams having different dimensions and physical constants. Corresponding theoretical results, obtained by means of a digital computer, are in close agreement with the experimental results.

Mixing of Compressible Fluids..61—APMW-3... By E. D. Kennedy, General Applied Sciences Laboratories, Inc., Westbury, L. I. N. Y. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

The problem of the mixing of two streams of the same compressible fluid in a constant-area duct is solved by applying certain dimensionless parameters first used by Kiselev. The extension to dissimilar fluids or to more than two streams is straightforward. Although the analysis is unrestricted, detailed results are given only for the case where one stream is sonic or supersonic and the other sonic or subsonic at the origin of mixing.

For this case, the second law of thermodynamics indicates that of the two solutions of the conservation equations the subsonic one is always permitted while some of the supersonic solutions are thermodynamically impossible. Upon examination of experimental data, it is further concluded that of the admissible supersonic solutions, only one may be expected to occur. The establishment of this supersonic solution with its relatively high stagnation pressure leads to the conclusion that when the initial temperatures are sufficiently different, there exist thermodynamically possible solutions with a stagnation pressure higher than that of either of the two initial streams.

On the Parametric Excitation of Pendulum-Type Vibration Absorber..61—APMW-4... By Eugene Sevin, Mem. ASME, Armour Research Foundation, Chicago, Ill. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

The free motion of an undamped pendulum-type vibration absorber is studied on the basis of approximate nonlinear equations of motion. It is shown that this type of mechanical system exhibits the phenomenon of autoparametric excitation; a type of "instability" that cannot be accounted for on the basis of the linearized system. Complete energy transfer between modes is shown to occur when the beam frequency is twice the simple pendulum frequency. On the basis of a numerical solution, approximately 150 cycles of the beam oscillation take place during a single cycle of energy interchange.

The Hump Deformation Preceding a Moving Load on a Layer of Soft Material..61—APMW-5... By G. R. Abrahamson and J. N. Goodier, Stanford University, Stanford, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

When a load, for instance a heavy roller, moves slowly along the surface of a solid mass of soft material, a "hump" deformation is often observed to precede it. The process of formation from an initially level surface, and the final form of hump established, are investigated analytically for a purely viscous material, in two-dimensional motion. It becomes evident that a material showing nonlinear creep, or a viscoelastic material, would show qualitatively similar behavior, the simple viscous model being adequate to exhibit the essential qualitative features.

Bowing of Cryogenic Pipelines..61—APMW-7... By W. G. Flieder and W. J. Smith, Arthur D. Little, Inc., Santa Monica, Calif.; and J. C. Loria, Arthur D. Little, Inc., Cambridge, Mass. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

The design of propellant loading systems for present-day missiles involves the design of pipelines that can carry cryogenic fluids and requires an additional consideration beyond the conventional analyses for flexibility and dead weight. Because of varying flow conditions and boil-off, these cryogenic lines experience varying fill levels and concomitant temperature gradients that cause these lines to bow; i.e., to assume a uniform curvature of circular arc.

If constrained, the thermal-stress distributions that generated by the temperature gradients will have superposed on them additional stresses, which result from the action of the support constraints. This combination of stresses may be critical and/or the loads on the supports may be excessive. The following analysis investigates these bowing effects and thermal stresses, and indicates the support problems entailed.

Permanent Periodic Surface Deformations Due to a Traveling Jet..61—APMW-6...By G. R. Abrahamson, Stanford Research Institute, Menlo Park, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in Trans. ASME—J. Appl. Mech. available to June 1, 1962).

A steel bullet in the form of a right circular cylinder which strikes a 10-mil-thick plane lead target at 45 deg incidence and at 2700 fps acquires on its front surface a series of corrugations, or waves, approximately 10 mils in amplitude and 40 mils in wave length. This phenomenon is investigated from a hydrodynamic point of view and it is found that similar waves develop at much lower velocities with materials that are viscous liquids under ordinary conditions. A mechanism of wave formation based on a hydrodynamic instability is presented.

Elastic-Plastic Design of Rectangular Pressure Tubing..61—APMW-8...By R. D. Gauthier, Mem. ASME, The Dow Chemical Company, Denver, Colo.; and E. E. Weibel, Mem. ASME, University of Colorado, Boulder, Colo. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in Trans. ASME—J. Appl. Mech.; available to June 1, 1962).

Elastic-plastic design permits the most effective use of the strength of the rectangular tube section. The condition of failure for a tube of perfectly elastic-plastic material is analyzed, and a formula is derived from which the limit load can be computed directly. A procedure is developed for determining by the area-moment method the wall deflection at any load from a bending-moment diagram modified to account for reduced rigidity.

The total deflections thus found are plotted against the various loads. This theoretical load-deflection curve then becomes the basis for design.

Dynamic Membrane Stresses in a Circular Elastic Shell..61—APMW-10...By R. G. Payton, Avco Research and Advanced Development, Wilmington, Mass. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in Trans. ASME—J. Appl. Mech.; available to June 1, 1962).

Three examples of the dynamic response of a circular elastic shell are considered in detail. In the first example, the dynamic response to a point impulse is found in closed form. Next, a distributed impulse and finally a moving pressure load are considered. These problems are solved within the framework of linear membrane-shell theory. No theoretical difficulties are added by the inclusion of bending terms. However, the resulting mathematics become more tedious.

These solutions, based on a method due principally to Friedlander, give new answers to the problems mentioned.

Dynamics of Nonholonomic Systems..61—APMW-9...By T. R. Kane, Stanford University, Stanford, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in Trans. ASME—J. Appl. Mech.; available to June 1, 1962).

A general method for obtaining the differential equations governing motions of both holonomic and nonholonomic systems is presented. When applied to holonomic systems, it differs from the method of Lagrange in this respect: The requisite kinematical analysis must be carried further than when one uses Lagrange's equations. That is, accelerations and, if the system contains rigid bodies, angular accelerations, must be studied, whereas Lagrange's equations, involving kinetic energies, can be formed as soon as sufficient information about velocities and angular velocities is available.

This is a disadvantage of the present method. However, it is less serious than it might appear to be, because the partial differentiations (of kinetic energy) required by Lagrange's method can at times become very laborious, even in situations in which the study of accelerations would not be so. Thus, for holonomic systems, the relative advantages of these two methods depend on the character of the problem under consideration.

As regards nonholonomic systems, the new method enjoys a clear-cut advantage over the Lagrangian one applicable to such systems; i.e., over the use of undetermined multipliers. Several supplementary theorems are stated, and the use of the method is illustrated by means of two examples.

Linearized Transonic Flow About Slender Bodies at Zero Angles of Attack..61—APMW-12...By P. F. Maeder, Mem. ASME, Brown University, Providence, R. I.; and H. U. Thommen, General Dynamics Corporation, San Diego, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in Trans. ASME—J. Appl. Mech.; available to June 1, 1962).

The simple linearized transonic flow theory as originally proposed by Oswatitsch and Keune and by the present authors is improved by considering and partially correcting its error. In this manner a theory that is easy to apply and that should be valid for a great number of smooth bodies is obtained. This improved theory predicts shock waves in the lower transonic regions. It is applied to a number of significant body and airfoil shapes and its predictions are compared with experiments and results of other theoretical investigations.

Shear Deformation in Beams on Elastic Foundations..61—APMW-14...By F. Essenburg, Assoc. Mem. ASME, Illinois Institute of Technology, Chicago, Ill. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in Trans. ASME—J. Appl. Mech.; available to June 1, 1962).

The importance of the effect of transverse shear deformation in the flexure of an elastic beam of symmetric cross section, constrained by a Winkler-type elastic foundation, is found to depend upon both the elastic properties of the beam and the foundation and the geometry of the beam cross section. Under certain conditions the form of the solution is substantially altered and the periodic character predicted by the classical treatment is not present.

The practical significance of these modifications is illustrated by means of the specific examples of an infinite beam under concentrated load and an infinite beam under concentrated couple.

Analysis for Calculating Lateral Vibration Characteristics of Rotating Systems With Any Number of Flexible Supports (Part 1)..61—APMW-15A...By E. C. Koenig, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in Trans. ASME—J. Appl. Mech.; available to June 1, 1962).

A method is presented for calculating the lateral vibration characteristics of rotating systems, and it establishes improved criteria for design. The method is also applicable to the vibration analysis of interconnected beam systems that are nonrotating and lying in a single plane.

This first part restricts itself to the development of the method of analysis. It not only gives the values of the resonant frequency of a rotor but also provides the following information:

1 Lateral deflections of the rotor, useful for (*a*) Calculating rotor stresses, (*b*) Determining clearances between rotor and stationary structures, and (*c*) Determining relative severity of vibrations at the different resonant frequencies.

2 Vibration amplitudes of the bearing supports, valuable for (*a*) Determining support resonant frequencies, where these resonant frequencies may be different than the resonant frequencies of the rotor, (*b*) Determining system performance since these are the vibrations physically observed and measured, and (*c*) Obtaining a best design of a system through modifications of the bearings and their supports as well as through modifications of the rotor.

The sensitivity and response of the bearing supports to rotor unbalance may be one of the factors which influence the design.

An Approximate Analytical Solution for the Stepped Bearing..61—APMW-11... By C. F. Kettleborough, University of New South Wales, Sydney, Australia. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

Previous solutions of the problem of the Rayleigh-type bearing with a step that is not straight have involved the use of the electrolytic tank or the use of relaxation methods, both of which are somewhat inconvenient compared with the approximate analytical method described in this paper. The solution of the derived differential equation is in the form of a convergent infinite series, but for rapid computation it is shown that an economized series (the τ method for the solution of linear differential equations) yields results of high accuracy.

A Note on a New Stability Method for the Linear Modes of Nonlinear Two-Degree-of-Freedom Systems..61—APMW-13... By Jack Porter and C. P. Atkinson, Mem. ASME, University of California, Berkeley, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

A method is presented for analyzing the stability of the linearly related modes of nonlinear two-degree-of-freedom oscillatory systems. For systems described by the coupled equations $\ddot{x}_1 = f(x_1, x_2)$ and $\ddot{x}_2 = g(x_1, x_2)$ there exist solutions related by the linear modal restraint $x_1 = cx_2$ where c is a constant. Such oscillations are not always stable. The method of this paper allows the prediction of the stability of the modes in terms of the amplitudes of the oscillations and the parameters of the equations of motion. Analog-computer results are presented that confirm the theoretical predictions.

Bending of Plates on an Elastic Foundation..61—APMW-15... By K. S. Pister, Mem. ASME, and R. A. Westmann, University of California, Berkeley, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

A two-dimensional elastostatic plate theory is discussed in which effects of both transverse strain and normal strain are retained. The governing system of equations is deduced as a limiting case of results obtained for thin shells by Naghdi. As an example of a class of problems for which such effects are significant, axisymmetric bending of an infinite plate resting on an elastic half space is discussed. Illustrative numerical results are included.

The results are parameterized by a load-concentration factor (ratio of plate thickness to radius of loaded area) and stiffness-modulus ratio (ratio of moduli of elasticity of plate and foundation). It is found that Reissner-type theory does not necessarily constitute an improvement over classical theory in the cases studied.

Analysis for Calculating Lateral Vibration Characteristics of Rotating Systems With Any Number of Flexible Supports (Part 2)..61—APMW-16B... By T. G. Guenther and D. C. Lovejoy, Assoc. Mem. ASME, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

Many methods have been developed in the past for calculating critical speeds, but it has often been found that the calculated natural frequencies, particularly the higher ones, were not the same as the observed natural frequencies.

Part 1 of this paper presents a method of calculating vibration characteristics of large rotor systems more accurately than by previous methods. It includes the effect of damping and flexibility of the oil films and mass and flexibility of the supports. The method includes the concept of support stiffness being a function of speed.

Part 2 describes a computer program based on that method, and shows the results of applying the program to various rotor systems. It is also shown that a proper description of support parameters is just as essential as the description of rotor geometry when predicting critical speeds of systems with flexible supports.

Dynamical Stress Concentration in an Elastic Plate..61—APMW-17... By Yih-Hsing Pao, Cornell University, Ithaca, N. Y. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

Stress concentrations around a circular cavity in an infinitely extended, thin elastic plate, during passage of plane compressional waves, are discussed. The dynamical stress concentration factors are found to be dependent on the incident wave length and Poisson's ratio for the plate, and, at certain wave lengths, they are larger than those encountered under statical loading.

On a Class of Oscillations in the Finite-Deformation Theory of Elasticity..61—APMW-18... By J. K. Knowles, California Institute of Technology, Pasadena, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

The author treats the large-amplitude radial oscillations of a perfectly elastic, incompressible cylindrical tube of infinite length due to suddenly applied pressures on its lateral surfaces. The motion is studied for materials with essentially arbitrary strain-energy density. Sufficient conditions for periodic motions and a formula for the period of oscillation are given in terms of the strain energy. The results are specialized to the case of a rubber-like material of Mooney type, and asymptotic formulas are given for the case of a thin shell and for the case of small applied pressure.

Nonsymmetric Deformation of Dome-Shaped Shells of Revolution..61—APMW-19... By C. R. Steele, Lockheed Missiles and Space Division, Sunnyvale, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

Bending solutions that are uniformly valid in both shallow and nonshallow regions of a dome with arbitrary meridian are determined for edge loads that vary sinusoidally in the circumferential direction. The membrane and inextensional deformation solutions are obtained in terms of a function that satisfies a simple integral equation, which eliminates the usual trial-and-error method of isolating the solutions that are regular at the apex. For a specific application, curves and formulas are obtained for the stresses and deformations of a dome with rigid rings clamped to the edges under the action of axial force, side force, and tilting moment.

Transient Response of a Dynamic System Under Random Excitation..61—APMW-20... By T. K. Caughey and H. J. Stumpf, California Institute of Technology, Pasadena, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.;** available to June 1, 1962).

The transient motion of a single-degree-of-freedom oscillator subjected to a stationary random input having an arbitrary power spectrum is analyzed. An approximate solution is presented for the case of small damping and a smooth power spectrum having no sharp peaks.

The application of the results of this analysis to determining the response of structures to strong motion earthquakes is discussed. It is concluded that:

1 The results of the analysis may be applied with some confidence to the very strong, long duration earthquakes, since the analysis did not assume a white process.

2 For the shorter earthquakes, some attempt should be made to account for the nonstationarity of the input process. This has been done for a particular class of inputs by Stumpf in his Doctoral thesis.

3 Some caution must be exercised in applying the distribution function for the displacement in the case of earthquakes. It is well known that the probability of exceeding a specified value is quite sensi-

tive to the tail of the distribution function, and this is the very area where our ignorance is greatest in the earthquake problem.

Green's Functions for Axially Symmetric Elastic Waves in Unbounded Inhomogeneous Media Having Constant Velocity Gradients..61—APMW-23... By J. F. Hook, University of California, Los Angeles, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to June 1, 1962).

The propagation of elastic waves in one class of inhomogeneous media is treated. The properties of the media are proportional to powers of the Cartesian coordinate z in such a way that Poisson's ratio remains constant and the velocities of propagation of P and S waves are proportional to z. Exact expressions are obtained for the P, SV, and SH displacements generated by impulsive point sources buried in unbounded media of this class. The sources are taken to be symmetric about the z-axis.

Separation of the vector-wave equation is achieved by use of a potential representation that is a generalization of the familiar Stokes-Helmholtz representation; the P, SV, and SH displacement vectors are expressed in terms of scalar potentials that satisfy independent second-order wave equations. The SH displacement is solenoidal, but it is found that the products of the P and SV displacement vectors with appropriate weighting functions, rather than the displacement vectors themselves, are irrotational and solenoidal, respectively. The media are found to be dispersive, with the result that decaying tails follow the advancing wave fronts.

On the Buckling of Truncated Conical Shells in Torsion..61—APMW-24... By Paul Seide, Mem. ASME, Aerospace Corporation, Los Angeles, Calif. 1961 ASME Applied Mechanics West Coast Conference paper (in type; to be published in **Trans. ASME—J. Appl. Mech.**; available to June 1, 1962).

The problem of the buckling of thin circular conical frustums in pure torsion is solved in a manner similar to that employed previously by the author for buckling under uniform hydrostatic pressure.

Synthesis of the numerical results indicates that the critical torsion of a truncated cone is equal to that of an equivalent cylinder whose length and thickness are the axial length and wall thickness of the cone and whose radius is a function of the semivertex angle and the taper ratio of the cone. Curves and equations to aid in the analysis of conical frustums are given. It is shown that a previous recommendation for the analysis of truncated cones in torsion may be seriously unconservative in some cases.

ASME TRANSACTIONS

Journal of Engineering for Power

The October, 1961, issue of the Transactions of the ASME—*Journal of Engineering for Power* (available at $1.50 per copy to ASME Members, $3 to nonmembers)—contains the following:

Vacuum Deaerator Design, by A. W. Kingsbury and E. L. Phillips. (60—WA-214)

Performance of Stainless-Steel Condenser Tubes, by R. H. Pell. (60—WA-217)

Evaluation of Steam Washers in Power-Plant Boilers, by H. A. Klein. (60—WA-213)

German Development in Acid Cleaning of High-Pressure Boilers, by H. G. Heitmann. (60—WA-227)

Acid Cleaning of Superheaters and Reheaters, by W. F. Ashton and S. M. Rose. (60—WA-219)

Precautions in the Use of Citric Acid for Chemical Cleaning, by E. B. Morris. (60—WA-221)

Inlet Guide Vane Performance of Centrifugal Blowers, by A. J. Stepanoff. (60—WA-130)

Dissimilarity Laws in Centrifugal Pumps and Blowers, by A. J. Stepanoff and H. A. Stahl. (60—WA-145)

The Significance of the Hall Effect for Three MHD Generator Configurations, by L. P. Harris and J. D. Cobine. (60—WA-329)

Experiments With MHD Power Generation, by S. Way, S. M. DeCorso, R. L. Hundstad, G. A. Kemeny, W. Stewart, and W. E. Young. (60—WA-328)

Power-Plant Performance Monitoring, by J. Kenneth Salisbury. (60—WA-222)

The Application of the Deviation Concept of Turbine Cycle Monitoring, by H. T. Hoffman and C. P. Welch. (60—WA-166)

Optimizing a Regenerative Steam-Turbine Cycle, by G. Chiantore, D. Borgese, F. Baldo, and J. H. Potter. (60—WA-179)

A Study of Sulfur Reactions in Furnace Deposits, by M. Weintraub, S. Goldberg, and A. A. Orning. (60—WA-183)

The Role of Chemical Thermodynamics in Analyzing Gas-Side Problems in Boilers, by R. H. Boll and H. C. Patel. (60—WA-182)

Corrosion of Superheaters and Reheaters of Pulverized-Coal-Fired Boilers, II, by Carl Cain, Jr., Wharton Nelson. (60—WA-180)

ASME Order Forms

Technical Papers

Pamphlet copies of numbered ASME technical papers are obtainable from the ASME Order Department, United Engineering Center, 345 East 47th Street, New York 17, N. Y. **Please order only by paper number;** otherwise orders will be returned. Papers are priced at 50 cents to members of ASME; $1 to nonmembers, plus postage and handling charges. You can save postage and handling charges by including your check or money order made payable to ASME and sending it with your order to ASME Order Department, United Engineering Center, 345 East 47th Street, New York 17, N. Y. Payment also may be made by free coupons, or coupons purchased from the Society in lots of ten at $4 to members; $8 to nonmembers.

Note: No digests are made of ASME papers published in full or condensed form in MECHANICAL ENGINEERING.

Copies of all ASME publications are on file in the Engineering Societies Library and are indexed by the Engineering Index, Inc., both of United Engineering Center, 345 East 47th Street, New York 17, N. Y.

ASME Order Department
United Engineering Center
345 East 47th Street
New York 17, N. Y.

Please send papers indicated by circled numbers:

61—SA-1	61—Pet-17	61—Mgt-1
61—SA-2	61—Pet-18	61—Mgt-2
61—SA-6	61—Pet-19	61—Mgt-3
61—SA-7	61—Pet-20	61—Mgt-4
61—SA-12	61—Pet-21	61—APM-18
61—SA-13	61—Pet-22	61—APM-19
61—SA-14	61—Pet-23	61—APM-24
61—SA-17	61—Pet-24	61—APM-25
61—SA-18	61—Pet-26	61—APM-26
61—SA-36	61—Pet-27	61—APMW-1
61—SA-40	61—Pet-28	61—APMW-2
61—SA-50	61—Pet-29	61—APMW-3
61—SA-51	61—Pet-30	61—APMW-4
61—SA-55	61—Pet-31	61—APMW-5
61—SA-58	61—Pet-32	61—APMW-6
61—SA-60	61—Pet-33	61—APMW-7
61—Pet-1	61—Pet-34	61—APMW-8
61—Pet-2	61—Pet-35	61—APMW-9
61—Pet-3	61—Pet-36	61—APMW-10
61—Pet-4	61—JAC-1	61—APMW-11
61—Pet-5	61—JAC-2	61—APMW-12
61—Pet-6	61—JAC-3	61—APMW-13
61—Pet-7	61—JAC-4	61—APMW-14
61—Pet-8	61—JAC-5	61—APMW-15
61—Pet-9	61—JAC-6	61—APMW-16A
61—Pet-10	61—JAC-7	61—APMW-16B
61—Pet-11	61—JAC-8	61—APMW-17
61—Pet-12	61—JAC-9	61—APMW-18
61—Pet-13	61—JAC-10	61—APMW-19
61—Pet-14	61—JAC-11	61—APMW-20
61—Pet-15	61—JAC-12	61—APMW-23
61—Pet-16	61—JAC-13	61—APMW-24

Name..................................

Address..................................

City......................**State**........

☐ **Remittance enclosed** ☐ **Bill me**

☐ **ASME Mem.** ☐ **Nonmem.**

Includes Letters from Readers on Miscellaneous Subjects

COMMENTS ON PAPERS

LETTERS

The Fourth Dimension

To the Editor:

Graduation of many engineers means the end of formalized, directed education toward the degree worked for so hard. Most of us have spent at least 16 years in school, some of us several years more, all aimed toward getting a degree in engineering. Congratulations are in order for all the successful efforts toward this end.

Stripped of all the gay trappings, names, honors, and words, engineering to most engineers means an interesting way of making a good livelihood. It must have been at least somewhat interesting to have sustained our periods of discouragement through specialized training but there are a few of us dedicated to the profession who are not interested in the financial rewards possible for the successful.

We have negotiated high school and college and believe that if we spend a moderate amount of time on professional improvement and the study of the problems of our jobs we should progress to better and more responsible jobs with consequent financial rewards. This is true of most engineers and should be so, but throughout all of this formalized educational period we have neglected the most important part of our education. Why is it that men will work so hard on their training and then on their jobs and still not accomplish what others in the company less trained and less qualified seem to do without half trying? Why is it that the best engineer is not always the one who is given the next raise?

The fourth dimension of the training of engineers is the training of the man to get along with his fellow man. Ask any experienced engineer. He can tell you of numbers of qualified engineers who have sought advancement in vain, been stepped over, or even fired because of lack of ability to deal with his fellow men without friction.

It's hard to find a case of a graduate engineer being "laid-off," if it's put gently, or fired for professional incompetence dealing with the technical area of his training. As most young graduates will find—the technical aspect of their engineering work will be easy compared to much of the technical work they have had to do in school. They will have at least eight hours a day to concentrate on only one narrow area of engineering, and if that's not enough, a few hours at night in the library should bring their knowledge of the job rapidly into focus.

The big part of a new job will be getting along with the people with whom and for whom they work. By this I don't mean "apple polishing," although a moderate amount of this can go a long way, but by recognizing the feelings and rights of others. Engineering teaches us to find the right formula, put in the right values, grind carefully, and out comes the answer. Try this in personal dealings with people and you are doomed to failure.

Here the recent graduate is on the brink of a new life in the business and professional world—almost completely unprepared for it. Surely his technical training is good and usually perfectly adequate for starting the job but is he prepared to get the right answers from people?

An engineer is measured and paid too for the fourth dimension in his training. He studied hard for the profession. To succeed at it he will need more than technical training. He will need to develop his ability to get along properly with others.

Like any other technique, one can profit from his mistakes. Analyze your relationships with others as carefully as you would your final exam—it means as much to you if not more!

The fourth dimension can be taught. Our colleges and universities some day will realize that it is as important as any of the technical courses they teach. Some men are fortunate and realize early how much this phase of training means to their success. Others learn from experience. A few never become aware of the reason for their failure but all of us can and should make the effort to train ourselves to handle people better, or handle ourselves better with people!

Morton A. Serrell.[1]

More and Better Engineers[2]

To the Editor:

". . . I object strongly to the contention that over-all technical superiority can be achieved by educating greater numbers of engineers. Quantity is, in this case, the enemy of quality . . . I question even the need for more engineers in our economy. Reading of the Business Section of *The New York Times*, the "Opportunities" Section of Mechanical Engineering, and the classified advertisements of the *Wall Street Journal*—plus conversations with good employment agencies—will tell a different story than that indicated in your editorial.

". . . What are American Industry and our research institutions doing with all the engineers they employ? Is their knowledge and ability utilized to the fullest extent? Couldn't technicians or clerical workers often free the engineer for creative work? Is the engineer given a proper environment to develop his ability

[1] Contracting engineer, PE, Industrial Piping Division, Grinnell Company, Inc., Charlotte, N. C. Mem. ASME.

[2] J. J. Jaklitsch, Jr., "Will We Be Second?" (editorial), Mechanical Engineering, vol. 83, September, 1961, p. 33.

and experience? How much unnecessary duplication and competition is there between our research institutions, the Armed Services, industry, etc.?

Philip C. Wolf.[3]

EDITOR'S NOTE: These are fair questions, and there are no easy answers. Would the quality of engineers be higher if there were fewer of them? Would they rate higher?

We believe the word "dedicated" is going to get a play before the answers are all in. Are engineers as dedicated to their profession as a generous percentage of medical doctors are dedicated to theirs? If not, is this a failure on somebody's part, and if so, whose?

Sometimes we may get a distorted picture, here at Headquarters, because we work with the dedicated engineers.

[3] Chief engineer, centrifugal pump department, De Laval Steam Turbine Company, Trenton, N. J. Assoc. Mem. ASME.

BOOKS RECEIVED IN LIBRARY

The Fermi Surface

Edited by W. A. Harrison & M. W. Webb, 1960, John Wiley & Sons, Inc., New York, N. Y. 356 p., 8³/₄ × 11¹/₄ in., bound. $10. This volume contains the 33 papers presented at a conference on the Fermi surfaces of metals, held in Cooperstown, N. Y., in August, 1960, sponsored by the Air Force Office of Scientific Research and the General Electric Company. Of the eight sections into which the papers have been organized, seven are topical, discussing the theory of the Fermi surface, the de Haas-van Alphen effect, galvanomagnetic effects, cyclotron resonance, the anomalous skin effect, the magnetoacoustic effect, transport properties, and studies of alloys. The final section contains summaries of the theoretical and of the experimental considerations dealt with in the conference. Participating were representatives from the U. S., Canada, Great Britain, Spain, France, and Japan, but there were no reports on Russian work in the field.

Flue Gas Corrosion in Boiler Plants

Report of the Flue Gas Corrosion Research Committee of the Danish Academy of Sciences. 1960, Danish Technical Press, Copenhagen, Denmark, 136 p., 7 × 9³/₄ in., bound. No price given. Report No. 38 of the Committee, this one is concerned with flue gas corrosion in boiler plants. The major part of the report deals with low-temperature corrosion, discussing in detail the formation of sulfur trioxide, and the formation, corrosive action, and methods of control of sulfuric acid. There is also a short section on high-temperature corrosion, and a chapter describing other aspects of the Committee's work in relation to such topics as corroded welds, dolomite injection, and oil analyses. A 30-page final section presents abstracts of literature from 1929 to date, selected for particular pertinency to this report. References also are given to complete surveys and summaries of literature on the subject of flue gas corrosion.

Fundamental Principles of Powder Metallurgy

By W. D. Jones. 1961, St. Martin's Press, New York, N. Y. 1032 p., 5³/₄ × 8³/₄ in., bound. $30. Dr. Jones considers his 1937 "Principles of Powder Metallurgy" to a certain extent an introduction to this present work, which "has not repeated . . . the subject matter" of the first book. In "Fundamental Principles. . ." he omits industrial processes and their products, except where they may be used to illustrate principles with which he is wholly concerned. As well as giving the historical background of the subject, and indicating areas where research is required, the author discusses subjects which he considers of importance to those in the field, but which are not generally considered part of P.M.—ferrites, dust cores, and sintering of nonmetallic materials. Contents: Manufacture of powders; pressing; shaping without pressing; sintering; attainment of specific qualities; continuous powder metallurgy; methods of control.

Hydrodynamics

By Garrett Birkhoff. Second Edition. 1960, Princeton University Press, Princeton, N. J. 184 p., 6 × 9¹/₄ in., bound. $6.50. The over-all organization of this edition closely follows that of the 1950 edition. The material, carefully revised in detail and including new developments in the past decade, was presented in a graduate course at Harvard University. Two special aspects of fluid dynamics are emphasized: the complicated logical relation between theory and experiment, and application of symmetry concepts. The relation between theory and practice, introduced in the first two chapters by cases wherein plausible reasoning had led to incorrect results, is closely studied in chapter 3 in the special cases of flows with free boundaries, and further illuminated by an analysis and justification of modeling in chapter 4. This chapter also introduces the second aspect dealt with, in describing the origins of modeling in symmetry concepts. Applications of these concepts are considered in the final two chapters, in solutions of problems involving compressible and viscous flows, and in developing the classical theory of virtual mass as a special case of the theory of homogeneous spaces.

Plasticity

Edited by E. H. Lee and P. S. Symonds. 1960, Pergamon Press, New York, N. Y. 611 p., 6¹/₂ × 10 in., bound. $10. This volume contains the 30 papers of the Second Symposium on Naval Structural Mechanics, held at Brown University in April, 1960, and sponsored by the University and the U. S. Office of Naval Research. The symposium was devoted to plasticity. The papers presented provide critical reviews of recent developments in six areas of particular current interest and importance—atomic theory of plastic flow and fracture, stress-strain relations, basic theory, boundary-value problems, dynamic loading and plastic waves, and developments in design; short accounts of related current research work; and other papers reviewing the present status of applications of plasticity in design of naval vessels.

Prophet of Progress—Selections From the Speeches of Charles F. Kettering

Edited by T. A. Boyd. 1961, E. P. Dutton and Company, Inc., New York, N. Y. 252 p., 5³/₄ × 8¹/₂ in., bound. $5. This fascinating sketch of a prominent engineer is made up principally of his own words. Each chapter is composed of excerpts of varying lengths from public utterances, selected for their relevance to the subject of the chapter. Chronology is a secondary consideration in the chapter arrangement, but the excerpts follow the chronological development of his ideas, showing in most cases a striking consistency indicative of early maturation. Mr. Kettering was a forthright, vigorous thinker, and expressed himself in clear, uncompromising, forceful English. The book also contains personal data such as a short biography and lists of the distinctions awarded him, of maxims from his speeches, and of his published speeches, interviews, and articles. An inspirational and entertaining book, of wide appeal.

Rumpf, Schalen- und Vollwandbauweise

By Gerd Otto. 1960, Friedrich Vieweg and Sohn, Braunschweig, Germany. 284 p., 5³/₄ × 8¹/₄ in., paper. DM 24.80. This first volume of a series on light construction techniques in the aircraft industry and other fields of application deals with the body of the airplane. It covers methods for both shell and solid-wall construction. The topics discussed include load factors, calculations for aircraft parts, landings, etc., dimensioning of structural units, and designs for different body types.

Spaceflight Technology (Proceedings of the First Commonwealth Spaceflight Symposium, 1959)

Edited by Kenneth W. Gatland. 1960, Academic Press, New York, N. Y. 365 p., 6 × 9¹/₄ in., bound. $11. Many of the 18 papers in this volume represent the first published results of original research; together, the papers are intended to foreshadow and encourage a technological program of aerospace development among British Commonwealth countries. The papers have been arranged into nine topical sections. The first section discusses Commonwealth activities in interplanetary exploration, with two papers concentrating on University participation and Canadian facilities. Section two deals with launching of space vehicles, discussing solid propellant rockets, nuclear thermal fission rockets, the Woomera tracking and launching station, and a spaceflight program based on Blue Streak. The three papers of section four are concerned with aero/space vehicles and re-entry, and the remaining five sections deal with propulsion systems; cabin-conditioning equipment for manned satellites; instrumentation of unmanned satellites; tracking, communication (Jodrell Bank), and navigation; and minimum propulsion for soft moon landing of instruments.

Synthetic Rubber Technology, Vol. 1

By W. S. Penn. 1960, Maclaren and Sons, Ltd., London, England. 325 p., 5³/₄ × 8¹/₂ in., bound. 50s. The author writes from many years of experience in industry, for technologists requiring a practical account of the compounding and processing of elastomers, without touching on their chemistry. The elastomers considered are SBR, high styrene resins, butyl, nitrile, and silicone rubber, neoprene, and Thiokol. The book describes the grades of synthetic rubber available, criteria for selection for particular uses, methods of compounding in general and for special products, modern processing techniques, and current applications. Standard polymers with more or less crystallized techniques were selected for discussion in this volume; a subsequent volume will take up newer methods for which the techniques are less codified.

Underwater Acoustics Handbook

By Vernon M. Albers. 1960, The Pennsylvania State University Press, University Park,

Pa. 290 p., 6 × 9¼ in., bound. $10. Despite its title, this book is more a detailed and careful study of sound transmission in sea water than a handbook, although the extensive table of contents and good index will make it also a valuable reference work. Part one discusses the nature of sound itself, and the units and reference standards of acoustics, briefly comparing underwater and air acoustics, and describing relevant physical characteristics of sea water, such as density, temperatures, salinity, marine organisms, and absorption and velocity of sound in sea water. Part two discusses the effects of these physical characteristics and other environmental factors such as rain and wind noise, thermal and depth variations, attenuation, reflection and refraction, upon sound transmission in this medium. Part three discusses methods and apparatus for underwater-sound generation and detection, and part four deals with the techniques of underwater-acosutic measurement and calibration.

Air Pollution

Published 1961 on behalf of the World Health Organization by the Columbia University Press, New York, N. Y. 442 p., 6½ × 9¾ in., bound. $10. One of the Monograph Series of the WHO, this work reflects world trends in air-pollution research. Participating in the project as contributors or editors were experts from the U. S., England, Belgium, Italy, India, and South Africa. Following a general introduction, the 14 individual papers discuss the following aspects of air pollution: Historical development; identification of the a-p problem; the role of meteorology in a-p; sampling, analysis, and instrumentation; effects of a-p on human health, animals, and plants; its physical and chemical nature; economic and social aspects, including specific legislation and enforcement; control by site selection, zoning, and process changes or equipment; fuel selection and utilization; and radioactive pollution.

Basic Principles of Fission Reactors

Interscience Publishers, Inc., 1961, New York, N. Y. 314 p., 6¼ × 9¼ in., bound. $7.50. This introduction to basic principles assumes a background of physics, mathematics, and chemistry, but none in nuclear technology, and employs a mathematical approach. The first two chapters introduce important ideas in nuclear engineering in preparation for the following chapter's discussion of a nuclear power station. Succeeding chapters contain detailed and quantitative discussion of the nuclear reactor itself, its various types and structural and operative aspects, stopping short of detailed design considerations. Attendant subjects such as radiation protection, health physics, waste disposal, and economic considerations are briefly discussed to place the reactor in proper perspective.

British Nuclear Power Stations

By Rolt Hammond. 1961, Macdonald and Company (Publishers) Ltd., London, England. 182 p., 5½ × 8¾ in., bound. 25s. In the first three chapters the author outlines the British Nuclear Power program for the next 20 years, and presents a general discussion of the design of nuclear power stations and the special problems of nuclear power. The remaining chapters give the stories of specific British nuclear power stations—Calder Hill, Hinkley Point, Berkeley, and Hunterston—discuss electrical control and switchgear, and give accounts of research in thermonuclear power, and with the Dounreay Sphere. Coordination of nuclear and conventional power plants to meet the fuel shortage expected about 1970 is also discussed.

LIBRARY SERVICES

Engineering Societies Library books, except bibliographies, handbooks, and other reference publications, may be borrowed by mail by ASME members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any item in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, United Engineering Center, 345 East 47th Street, New York 17, N. Y.

The Complete Scientist

Oxford University Press, 1961, New York, N. Y. 162 p., 5¾ × 8¾ in., bound. $2.90. "An enquiry into the problem of achieving breadth in the education at school and university of scientists, engineers, and other technologists" as the subtitle indicates, this is a report of the Leverhulme Study Group to the British Association for the Advancement of Science. It reviews for the first time and considers as a whole the successive stages in the education of the would-be graduate scientist or engineer from elementary school to the postgraduate course.

Der Deutsche Steinkohlenbergbau, Vol. 4: Aufbereitung der Steinkohle, Part 1.

Verlag Glückauf GmbH, 1960, Essen, Germany. 407 p., 8½ × 11¾ in., bound. No price given. Part 1 of the fourth volume of this extensive treatise on coal deals with preparation, including basic theory, classification, and separation. About three fourths of the book are devoted to the latter, with all the major processes—dry, wet, and upwash, flotation, electrostatic and Convertol, etc.—covered. The book is handsomely printed and illustrated.

E.I.T. Review

By Virgil M. Faires and Joy O. Richardson. 1961, Prentice-Hall, Inc., Englewood Cliffs, N. J. 256 p., 6¼ × 9¼ in., bound. $9. The objective of this book is to reiterate basic engineering principles and ideas and to direct the reader to pertinent information in other publications, as preparation for state registration examinations for engineer-in-training or a professional engineering license. The material is briefly stated, covering only the most fundamental principles in each section. Each chapter includes a list of selected references and illustrative problems with answers. Topics covered include mathematics in general, centroids, vectors, kinematics, statics, kinetics, strength of materials, thermodynamics, fluid mechanics, heat transfer, electricity, chemistry, physics, and engineering economy—a scope which indicates the brevity of treatment in each chapter. The final chapter contains sets of questions relevant to specific fields of professional practice.

High-Strength Steels for the Missile Industry

Edited by H. T. Sumsion. 1961, American Society for Metals, Metals Park, Novelty, Ohio. 276 p., 8½ × 9¼ in., bound. $12. This volume contains the seven papers presented at the symposium on high-strength steels for the missile industry occurring during the Golden Gate Metals Conference held in February, 1960, at San Francisco, Calif., under the sponsorship of the ASM. The papers discuss special problems of these steels in fabrication methods, and their applications in pressure vessels and rocket cases; stress corrosion of steels for aircraft and missiles; and NASA's program and findings on the effects of high-stress concentrations on high-strength sheet alloys. Three extra papers are included: On metallurgical tests as a contribution to pressure-vessel reliability; on fabrication techniques applicable to rocket motors; and on future applications of high-strength steels.

Liberal Education and Engineering

By Edwin J. Holstein and Earl J. McGrath. 1960, Bureau of Publications, Teachers College, Columbia University, New York, N. Y. 132 p., 6 × 9 in., paper. $2.75. This monograph is the ninth in a series reporting studies made by the Institute of Higher Education of Teachers College, Columbia University, of undergraduate professional curriculums. It deals with the issues and practices in engineering education related to the overriding problem facing American higher education today: How to provide both the specialized education required for technological progress, and the general education essential to ideological strength. The place of the liberal arts instruction in American higher education generally and in engineering education specifically is discussed from the historical standpoint. The monograph then reviews practices as revealed in the literature and in visits to a number of engineering schools. The concluding chapters summarize contemporary issues and present certain suggestions for their resolution.

Modern Physics for the Engineer

Edited by Louis N. Ridenour and William A. Nierenberg. 1961, McGraw-Hill Book Company, Inc., New York, N. Y. 383 p., 6¼ × 9¼ in., bound. $9.50. Volume two in the University of California Engineering Extension Series designed to give engineers a brief account of recent developments in physics, this book contains 15 lectures given during the academic year 1957–1958 at various institutions in California. The lectures have been arranged into three topical sections. Part 1, "The Laws of Nature," contains eight lectures dealing with new particles, nuclear shell structures, electron scattering, electrons and nuclei in ideal crystals, liquid helium, superconductivity, and magnetohydrodynamic waves. Part 2, "Man's Physical Environment," presents three lectures discussing the origin of nuclear species by means of nuclear reactions in stars, radio astronomy, and the origin of the earth's magnetic field. The four lectures in the final part of the book, "Technology," examine controlled thermonuclear fusion, nuclear reactors, particle accelerators, and the frontiers of aerodynamic research.

Theory of Elastic Stability

By Stephen P. Timoshenko and James M. Gere. Second Edition. 1961, McGraw-Hill Book Company, Inc., New York, N. Y. 541 p., 6¼ × 9¼ in., bound. $15. This second edition of a book on the stability of structures emphasizes fundamental theory. The authors have brought their material up to date and added new material on the buckling of bars under the action of nonconservative forces, periodically varying forces, and impact; on the determination of critical loads of columns by successive approximations; on the tangent modulus in the elastic buckling of beams; and on the buckling of plates.

Revise Pars. (7) and (10) of the Reply to be identical with the revisions shown for Case 1204-9.

ASME BOILER AND PRESSURE VESSEL CODE

Interpretations

The Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 345 East 47th Street, New York 17, N. Y.; (2) copies are distributed to Committee members for study; (3) at the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) they are submitted to the Board for action; (5) those which are approved are sent to the inquirers and are published in Mechanical Engineering.

(The following Case Interpretations were formulated at the Committee meeting June 23, 1961, and approved by the board on Aug. 30, 1961.)

Annulment of Cases

Case No. 1286

Reason for Annulment: Essence of Case included in Par. UCS-11(c)

Case 1064-2
(Special Ruling)
Low-Pressure Heating Boilers of Copper or Copper-Base Alloys

Revise as follows:

In the Reply, first subparagraph of Par. 7:

The welding qualification requirements for these materials shall be in accordance with Section IX for materials falling within the scope of Tables P Group Number P-31 for copper, P-32 for brass and P-34 for cupro nickel for the specifications listed in Table QN-11.1 of Section IX.

In the Reply, Par. 8, revise to read:

All welding shall be done in the flat position.

Delete—precautionary note

Case 1188-2
(Special Ruling)
Copper-Chrome-Nickel

Revise as follows:

In the Reply, Par. (6):

All joints of categories A and B (see Par. UW-3) shall be of Types No. (1) or No. (2) of Table UW-12.

Par. (7), delete the word: main

Case 1204-9
(Special Ruling)
Quenched and Tempered Steel

Revise as follows:

In the Reply, Par. (7) delete: Double welded butt-joints or their equivalent and replace with: Butt-welded joints.

Revise Par. (10) as follows:

All joints between material covered by this Case of categories A, B, C and D (see Par. UW-3) shall be of Type No. (1) of Table UW-12. Joints made with backing strips shall be examined by the magnetic-particle method after removal of backing strips and prior to the required full radiographing. All openings regardless of size shall meet the requirements for reinforcing.

Case 1214-1
(Special Ruling)
Alloy Steel Plate, SA-212 Modified

Revise as follows:

In the Reply, Par. (5):

All joints of categories A and B (see Par. UW-3) shall be of Type No. (1) or No. (2) of Table UW-12.

Case 1258-2
(Special Ruling)
Unalloyed Titanium; B 265-58T

Revise as follows:

In the Reply Par. (2)(c):

All joints of categories A and B (see Par. UW-3) shall be of Types No. (1) or No. (2) of Table UW-12.

In Par. 3(b), first sentence, delete: If a vessel incorporates main longitudinal or circumferential joints and replace with: If a vessel incorporates joints of categories A or B of Par. UW-3.

Case 1297-2
(Special Ruling)
Quenched and Tempered Steel

Revise Pars. (7) and (10) of the Reply to be identical with the revisions shown for Case 1204-9.

Case 1253
(Special Ruling)
Leaded Steel Forgings

Inquiry: Is it permissible in welded construction conforming to the requirements of the Code to use carbon steel forgings containing 0.15 to 0.35 per cent lead but otherwise conforming to the requirements of Specifications SA-105, Grades I and II and SA-181, Grades I and II?

Reply: It is the opinion of the Committee that the materials specified in the Inquiry may be used in the construction of welded pressure vessels under the rules of the Code provided the following additional requirements are complied with:

1 The maximum thickness of welds shall be 4 in.

2 The maximum operating temperature shall not exceed 550 F.

3 The maximum allowable stress values shall be the same as those given for the comparable specifications without lead.

4 The qualification of welding procedures and the welders shall conform to Section IX for comparable specifications without lead.

5 Overlay or joining by welding of this material with stainless steel or other high alloys is prohibited. These leaded materials shall be welded only with carbon steel filler metals.

6 Check analysis for lead shall be made from the part representing the bottom-most point of the ingot as used.

7 When these leaded steel forgings are used, it shall be so indicated on the data reports and reference made to the Case.

Case 1298-2
(Special Ruling)
Quenched and Tempered Steel

Revise Pars. (7) and (10) of the Reply to be identical with the revisions shown for Case 1204-9.

Case 1270N-4
(Special Ruling)
General Requirements for Nuclear Vessels

Inquiry: Neither Section I nor Section VIII of the ASME Boiler and Pressure Vessel Code as now written precisely covers pressure vessels that are an integral part of a nuclear installation. Under what rules shall they be constructed?

Reply: The Committee recognizes that in the design of nuclear installations,

some requirements will differ from those of conventional boilers and pressure vessels.

1 It is the opinion of the Committee that vessels that are an integral part of nuclear installations built in accordance with the requirements of the ASME Boiler and Pressure Vessel Code as modified or defined in this Case and subsequent Cases designated by the suffix "N" after the Case number meet the intent of the Code, and each vessel shall be marked as required by the section to which it is built including the appropriate Code symbol. In addition, the words "Case 1270N" shall appear on the Data Report for all vessels built under this and subsequent Cases (latest revisions of Cases 1271N to 1276N inclusive) dealing with nuclear vessels.

2 All vessels that are an integral part of nuclear installations shall be constructed in accordance either with the requirements of Section I or else with the requirements of Section VIII (Par. U-1 (g) shall not apply), except as these requirements are specifically modified in this and subsequent Cases dealing with nuclear vessels. Where differences exist between the requirements of the nuclear Cases (Cases with the letter N after the Case number) and the requirements of Section I or Section VIII, the requirements of the nuclear Cases shall take precedence over the Code rules for the subject covered.

3 The requirements of the nuclear Cases replace the special requirements of Par. UW-2 of Section VIII of the Code. The Code rules are intended to provide minimum safety requirements for new construction, and not to cover deterioration which may occur in service as a result of corrosion, erosion, radiation effects, instability of the material, or operating conditions such as transient thermal stress or mechanical shock and vibratory loading; nevertheless particular consideration shall be given to these effects with a view to obtaining the desired life of the vessel.

4 It is intended that jurisdiction over piping external to vessels shall terminate at:

(*a*) The first circumferential joint for welding end connections excluding the connecting weld or;

(*b*) The face of the first flange in bolted flange connections or;

(*c*) The first threaded joint in that type of connection.

5 Definitions

(*a*) The reactor vessel is any vessel, any tube, or any assemblage of tubes, regardless of size, in which nuclear fuel is present and in which the nuclear chain reaction takes place.

(*b*) Primary vessels are those vessels regardless of size, other than the reactor vessels (See (5)(a)), which are an integral part of the primary coolant system during normal operation and which contain or may contain coolant at the operating conditions of radioactivity level, pressure and temperature. Vessels having more than one chamber are further classified into:

(1) Those portions in direct contact with the primary fluid.

(2) Those portions not in direct contact with the primary fluid.

(*c*) A calandria vessel is one which contains liquid moderator and through which pass tubes in which the fuel is placed and through these tubes coolant passes. A calandria vessel or vessels may be constructed with (1) internal tubes through which the primary coolant tubes pass without mechanical restraint or (2) the primary coolant tubes may be welded or otherwise joined to the ends of the calandria. The entire calandria vessel is classed as a primary vessel. This paragraph is not intended to limit the use of multiple calandria vessels in a single reactor.

(*d*) Containment vessels are those outer vessels which enclose the reactor vessel or portions of the primary coolant circuit or both. The containment vessels are not normally pressurized and are built to contain the radioactive substances that may be released in case of an accident or failure of the reactor vessel or the primary coolant circuit or both.

(*e*) Intermediate containment vessels are those vessels within the containment vessel which enclose a portion or all of the primary reactor vessel. The intermediate containment vessels may or may not be pressurized during normal operation but they are intended to contain the primary coolant that may be released in case of an accident or failure of the vessel which they enclose.

(*f*) Secondary vessels are all other vessels which do not contain reactor coolant or are not otherwise subject to irradiation.

Case 1272N-4

(*Special Ruling*)

Containment and Intermediate Containment Vessels

Inquiry: Under what variations from Case 1270N and the rules of Section VIII may containment vessel and intermediate containment vessels, as defined in Case 1270N, be built and be acceptable as meeting the requirements of the Code?

Reply: It is the opinion of the Committee that containment and intermediate containment vessels meet the intent of the Code and shall be marked in accordance with Case 1270N provided the following requirements are met:

1 *Containment Vessels*

(*a*) Welded joint type and radiography: The requirements for the welded joint type and radiography of the four categories of joints as defined in Par. UW-3 are as follows:

(1) All welded joints of category A and B shall be of Type No. (1) in Table UW-12 and shall be fully radiographed.

(2) All welded joints of category C shall meet the detail requirements in Figs. UG-34, UA-6 and/or UA-48 and joints of category D shall meet the detail requirement in Fig. UW-16.1 as they apply. Joints of categories C and D shall be radiographed if a radiographable joint is used and shall be examined for cracks by magnetic particle or by fluid penetrant or by ultrasonic method of inspection if a non-radiographable joint detail is used.

(3) All other welds on doors, opening frames, attachment welds, etc., which are not covered by categories A, B, C, and D of Par. UW-3 shall be examined for cracks by magnetic particle, or by fluid penetrant or by ultrasonic method of inspection.

(*b*) Stress Relief: Containment vessels of carbon or low alloy steel shall be stress-relieved in all thicknesses in accordance with the requirements of Section VIII except that the requirements for stress-relief are waived for vessels that meet all of the following requirements:

(1) Plates and forgings of containment vessels exposed to the elements (not inside a heated enclosure) shall conform to specifications SA-300 for plates and SA-350 for forgings. These and other materials and the construction shall meet the impact test requirements of Par. UG-84 at a temperature at least 30 F below the lowest recorded ambient temperature of the area in which the containment vessel is to be erected, except that the lowest test temperature may be assumed to be −50 F for any part of the United States.

(2) All doors, nozzles, and opening frames shall be preassembled into shell plate and stress-relieved as complete assemblies for welding into the shell. Also, special consideration should be given to make the design of the reinforcement for large openings as strong as the shell (see Par. UA-7).

(3) The thickness of the shell and head plate shall not exceed that for which stress-relieving is required in accordance with Par. UCS-56, except that for materials listed under Group P—number 1 in Table UCS-23, stress-relieving is not required in thicknesses over $1^1/_4$ in., and

up to $1\frac{1}{8}$ in., inclusive, provided a preheat of 200 F is used during welding.

(4) Welded Attachments: All attachment welds to pressure parts except round studs up to and including $\frac{3}{8}$ in. diameter shall be welded using a qualified procedure used for welding shell joints of the vessel. Material used for nonpressure parts, permanently welded directly to pressure parts of impact tested material, which are not subsequently stress-relieved shall also be of similar impact-tested material. This material shall extend 16 times the attachment weld thickness beyond the vessel wall before other material shall be attached by welding. Other Code materials (except those of structural quality and SA-53 pipe) in the P-1 Group of Table UCS-23, up to and including $\frac{1}{2}$ in. thickness, may be welded to impact-tested shell material provided the weldment is stress-relieved.

2 *Intermediate Containment Vessels*

(*a*) Intermediate containment vessels that are not required to contain radioactive materials under normal operating conditions shall be constructed in accordance with the requirements of Section VIII, except that Par. UW-2 shall not apply.

(*b*) All other intermediate containment vessels shall be constructed in accordance with the requirements of item (1) of this Case exclusive of subparagraph (1)(b)(1).

3 *Corrosion*

Provisions for corrosion shall be made in accordance with Par. UG-25. The mandatory requirements of Par. UCS-25 are not intended to apply to containment and intermediate containment vessels.

4 *Two-Stage Construction*

Inspection of welded joints in the lower part of containment vessels during the pneumatic test is waived where such joints are covered by concrete during the construction of the vessel, provided:

(*a*) There are no openings or penetrations of the part of the vessel covered by concrete, and

(*b*) All welded joints that are inaccessible for inspection during the test of the completed vessel shall be Type No. (1) of Table UW-12 and shall be fully radiographed and prior to being covered shall be tested for leak tightness using a gas medium such as Halide Leak Detector Test.

5 *Allowable Stresses for Containment Vessels and Intermediate Containment Vessels*

In lieu of the increase in pressure permitted by Par. UG-125(c) for vessels provided with pressure relief devices, containment vessels and intermediate containment vessels not provided with pressure relief devices as permitted in Item (2) of the REPLY to Case 1271N may be designed in accordance with the formulas and rules of Section VIII, as modified by this Case, with allowable stress values 1.1 times those given in Table UCS-23, provided the following requirements are met:

(*a*) The requirements of Par. (1) or (2) of this Case are met.

(*b*) The design pressure and temperature are based on the maximum values which will be attained during the most severe credible incident, irrespective of the duration of the pressure, and provision shall be made for any vacuum conditions that may occur.

(*c*) For pressures and temperatures imposed during normal operation of the plant, the formulas of Section VIII are used with allowable stress values the same as those given in Table UCS-23.

(*d*) Hydrostatic tests made in accordance with Par. UG-99 are made at 1.35 times the design pressure at test temperature, and pneumatic tests made in accordance with Par. UG-100 are made at 1.15 times the design pressure at test temperature.

(*e*) Reinforcement of openings designed in accordance with the rules of Section VIII are based on shell thicknesses determined from the present stress values given in Table UCS-23 using the pressure and temperature from (b) above.

(*f*) Secondary stresses,* such as, for example, those which occur at changes in geometry of the structure or are produced by thermal gradients within the structure, shall be calculated on the assumption of elastic behavior, combined with the stresses calculated in accordance with Par. (5)(g) following, and the sum of such stresses shall be limited to three times the allowable stress values given in Table UCS-23.

(*g*) Primary stresses,** such as, for example, those which are produced by weight, pipe loads, wind, snow or specified live loads, shall be combined with the primary stresses calculated by the formulas of Section VIII, and the sum of such stresses shall be limited for design conditions on final supports as follows:

(1) General membrane stresses to 1.1 times the allowable stress values given in Table UCS-23.

(2) Combined general membrane, general bending, and local membrane stresses to 1.5 times the general membrane stress values permitted by (5)(g)-(1).

---

* Secondary stress, for the purposes of this Case, shall be defined as a stress developed by the constraint of adjacent parts or by self-constraint of a structure. The basic characteristic of a secondary stress is that it is self-limiting; local yielding or minor distortions can satisfy the conditions which cause the stress to occur, and failure from one application of the stress is not to be expected. Examples of secondary stresses are:

1 Discontinuity stress in the longitudinal direction at a head-to-shell or nozzle-to-shell junction, and

2 All thermal stresses acting on a shell except the effect of forces and moments produced by expansion of connected piping system.

** Primary stress, for the purposes of this Case, shall be defined as a stress developed by the imposed loading which is necessary to satisfy the laws of equilibrium of external and internal forces and moments. The basic characteristic of a primary stress is that it is not self-limiting and therefore a primary stress which exceeds the yield strength may result in failure or gross distortion. Examples of primary stresses are:

1 General membrane stress in a shell produced by internal pressure or distributed live loads, and

2 Local membrane stresses in a shell produced by the external load and moment at a permanent support or nozzle neck, and

3 Local membrane stresses acting circumferentially at points of discontinuity, such as head-to-shell or nozzle-to-shell junctions.

Case 1276N-1

(*Special Ruling*)

Special Equipment Requirements

Revise as follows:

In the Reply item (1):

All welded joints in the bellows portion of the expansion joint are of Type No. (1) of Table UW-12 and are fully radiographed.

In item (2), revise the first sentence:

The bellows portion of the expansion joint is attached to the vessel by circumferential welds of a butt type having full fusion and penetration through the thickness of the bellows portion as exemplified by sketches 1 and 2.

Case 1303

(*Special Ruling*)

Use of Acicular Iron for Unfired Pressure Vessels

Inquiry: Is it permissible to construct unfired pressure vessels in accordance with the requirements of Section VIII of the Code using cast iron conforming to Specification SA-278, Classes 50 and 60, modified as follows, when the size of the casting is in accordance with paragraph 4(c) of that specification?

Chemical Composition	Per Cent
Total Carbon	?.70–3.05
Nickel	1.50–2.40
Molybdenum	0.50–1.00
Manganese	0.60–1.00
Silicon	1.25–1.80
Phosphorus	0.10 max
Sulphur	0.10 max
Chromium	0.10 max
Copper	0.40 max

2 Instead of stress-relief as required by paragraphs 2(b) and (c) of the specification, castings shall be heat-treated as follows to produce acicular iron.

(*a*) Austenitize at 1475 to 1525 F for a minimum of three hours.

(*b*) Cool in air from austenitizing temperature to 1300 F ± 25 F, then control cool in air from 1300 to 1100 F ± 25 F at an average rate of 950 to 1200 F per hour, and from 1100 to 600 F at an average rate not exceeding 400 F per hour.

(*c*) Draw at 600 F for at least five hours plus one hour for each inch of thickness of the controlling section.

Reply: It is the opinion of the Committee that unfired pressure vessels may be constructed under the requirements of Section VIII of the Code using cast iron as specified in the inquiry with the following additional provisions:

1 Maximum allowable stress values shall be as required by Par. UCI-23.

2 Maximum metal temperature shall not exceed 450 F.

3 Hardness shall be determined at a minimum of three locations on a cross-section of an integral test piece and shall be not less than 250 Brinell.

Case 1304

(*Special Ruling*)

Aluminum Alloys 5083-0 and 5456-0 Specification SB-209

Inquiry: Specification SB-209 lists the mechanical property requirements for plate of aluminum alloys 5083-0 and 5456-0 in thicknesses up to 2.000 in. Would the intent of the Code be met if this thickness limitation were raised to 3.000 in.?

Reply: It is the opinion of the Committee that the intent of the Code would be met if the thickness limitation on aluminum alloys 5083-0 and 5456-0 in specification SB-209 were raised to 3.000 in., provided the mechanical property requirements are unchanged and the allowable stress values listed in Table UNF-23 of Section VIII are used in design.

Case 1273N-6

(*Special Ruling*)

Nuclear Reactor Vessels and Primary Vessels

Revise as follows:

Inquiry: Under what special rules shall a nuclear reactor vessel or a primary vessel, as defined in Case 1270N, be built in order to be acceptable for Code construction?

Reply: Pending development of more complete rules to cover nuclear vessels, it is the opinion of the Committee that a reactor vessel or a primary vessel shall meet the requirements of this Case in order to meet the intent of the Code and to be stamped in accordance with Case 1270N. The requirements of this Case are:

1 The thickness of each part of the vessel shall not be less than that determined by the Code rules using the applicable formula for the part with S values from the appropriate table in Sections I or VIII.

2 The combination of stresses evaluated under item (1) with thermal stresses due to temperature distributions at any level of steady power operation, including internal-heat generation, shall not exceed $1^1/_2$ times the S value.

3 For operating metal temperatures up to 800 F, the maximum allowable bolt design stresses as used in Code formulas may be based on heat treated properties for operating metal temperatures 100 F or more below the tempering temperature, provided the stresses do not exceed $^1/_3$ of the yield strength at temperature.

4 (*a*) Due regard shall be given to the creep and stress-rupture properties for prolonged exposure at temperature in order to assure adequate safety under all conditions of operation.

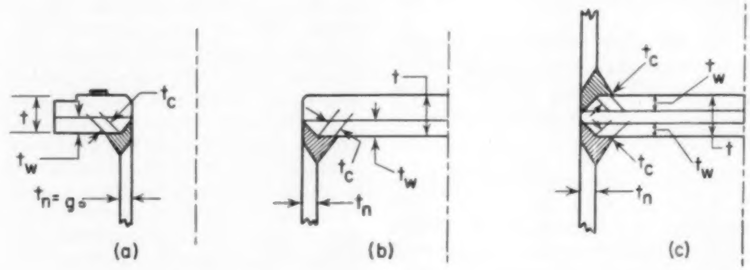
(*b*) Each design detail shall be carefully considered to provide against operational failure such as might occur from thermal stress, external pipe reactions, or control rod drive shock.

5 Compensation shall be made for all openings regardless of diameter. Compensation shall be on either the reinforcement basis or the ligament efficiency basis as given in Section I or Section VIII. Any compensation required shall be integral with the vessel wall or the nozzle or some with each. Properly deposited and inspected weld material may be included as part of the compensation.

6 Welded joint type and radiography (categories A & B): Except as otherwise provided in item (13), all welded joints of categories A & B as defined in Par. UW-3 shall be in accordance with Type No. (1) of Table UW-12 and these joints shall be fully radiographed.

7 Welded joint types and inspection (category C): All welded joints of category C as defined in Par. UW-3 shall be in accordance with one of the following:

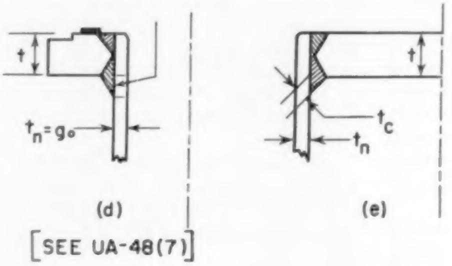
(*a*) Type No. (1) of Table UW-12 shall be fully radiographed. Examples are flange details (6), (6a) and (6b) of Fig. UA-48, and flat head detail Fig. UG-34(d).



t_c MIN. = 0.7t_n OR 1/4 IN. WHICHEVER IS LESS.

$t_w = 2t_r$ [t_r = REQUIRED THICKNESS OF NOZZLE OR SHELL-DUE TO PRESSURE] BUT NOT LESS THAN 1.25t_n OR GREATER THAN t

0.25 g_o BUT NOT LESS THAN 1/4 IN., THE MINIMUM FOR EITHER LEG (SEE FIG. UA-48(7)).



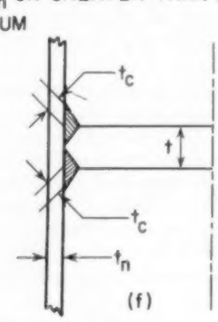


FIG. 5-ACCEPTABLE FULL PENETRATION WELDED. DETAILS FOR CATEGORY C JOINTS, RADIOGRAPHABLE WITH DIFFICULTY AND GENERALLY REQUIRING SPECIAL TECHNIQUES INCLUDING MULTIPLE EXPOSURES TO TAKE CARE OF THICKNESS VARIATIONS. (SEE PAR. 7 (b) AND (c)).

(*b*) Full penetration corner weld similar to Fig. 5(a), 5(b), and 5(c) and shall be examined to the radiographic standards of Par. UW-51 or Par. P-102. The radiography of this detail is recognized as requiring special techniques, including multiple exposures, and these techniques shall be subject to the approval of the inspector.

For Figs. 5(b) and 5(c), the value of C to be used in the formula in Par. UG-34 or Par. P-198 shall be 0.5.

(*c*) Full penetration corner weld similar to Fig. 5(d), 5(e) and 5(f) and shall be radiographically examined to the radiographic standards of Par. UW-51 or Par. P-102 and the special radiographic techniques required shall be subject to the approval of the inspector. In addition, the fusion zone and the parent metal beneath the attachment surface shall be ultrasonically inspected after welding to assure freedom from lack of fusion and laminar defects. The ultrasonic inspection and the standards in quality shall conform to Case 1275N. Examples are flange detail Fig. UA-48(7), bolted cover details ((a) integral) and (d) of Fig. UA-6. For Fig. 5(e) and (f) the value of C to be used in the formula in Par. UG-34 or Par. P-198 shall be 0.5.

8 Welded Joint Types and Inspection (Category D Joints). (a) through (g) same as 6(a) through (g) 1273N-5 except in Par. (6)(a)(1) revise Figs. 1, 2, and 3 to read Figs. 1, 1A, 2 and 3. Also, under Par. (6)(b) revise Fig. 1 to read Figs. 1 and 1A.

9 All reactor and primary vessels of carbon and low alloy steel shall be stress-relieved in accordance with the procedures described in Section I or Section VIII of the Code.

10 through 12 same as present 8 through 10 of Case 1273N-5.

13 Those portions of primary vessels not in contact with the primary coolant as defined in (5)(b)(2) of Code Case 1270N-4 shall be constructed in accordance with the requirements of Section I or Section VIII of the Code except that Par. UW-2 shall not apply and the following requirements shall be met:

(*a*) All welded joints of category A in Par. UW-3 shall be in accordance with Type No. (1) of Table UW-12 and all welded joints of category B in Par. UW-3 shall be in accordance with Types No. (1) or No. (2) of Table UW-12 and these joints shall be fully radiographed.

(*b*) The special requirements of this Case and nuclear Cases 1271N, 1272N, 1274N, 1275N and 1276N do not apply to these portions of primary vessels.

Note: Figs. 1, 1A, 2, 3, and 4, same as shown in Case 1273-5. Add new Fig. 5.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the semi-annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Power Boilers, 1959

PAR. P-3, revise: In the first line after electric furnace add basic oxygen

PAR. P-3(2), add specification SA-423

PAR. P-9(d), revise: In the second line after electric furnace add basic oxygen

PAR. P-21(a), add specification SA-423.

PAR. P-23(a), revise E = 0.95 for fusion welded joint to read:

For fusion welded joints, E = efficiency specified in Par. P-102.

PAR. P-102, revise the first sentence to read:

In applying the rules in Pars. P-23 and P-180, a welded joint efficiency of 100% may be used provided . . .

PAR. P-103(a), add specification SA-423

PAR, P-274, revise the first sentence to read:

The minimum safety valve relieving capacity for other than electric boilers shall be determined . . .

Add the following as a second paragraph:

The minimum safety valve relieving capacity for electric boilers shall be $3^1/_2$ pounds per hour per kilowatt input.

Table P-7, make the following revisions:

Delete Note (8) after SA-376, Grade TP-348

Add Note (13) after SA-240 for all grades

Add Note (13) after SA-376 for all grades

Add Note (13) after SA-336 for Grades F8, F8M, F8t and F8c

SA-326, page 28, should read SA-336

SA-240, Grades S, S, M, T, C no longer listed in Section II should read 304, 304, 316, 321 and 347, respectively.

PAR. P-27(b), (c), (d), (e) and (f), delete these paragraphs and replace with the following:

P-27(b) A factor not to exceed 100 per cent shall be applied when the casting meets the following requirements:

1 All steel castings 4 in. nominal body thickness or less, other than cast steel flanges and fittings complying with ASA B16.5-1957, shall be inspected as follows:

(*a*) All critical areas shall be radiographed and the radiographs shall conform to the requirements of ASTM Specification E-71-52, "Industrial Radiographic Standards for Steel Castings, "Class 1 or Class 2 depending upon the section thickness.

(*b*) All surfaces, including machined gasket seating surfaces, shall be examined by magnetic particle inspection. In the case of non-magnetic materials, penetrant oil and powder methods shall be used. Indications exceeding Degree 3 of Types I, II, and III and exceeding Degree I of Types IV and V of ASTM designation E125-56T shall be removed. The technique for magnetic particle inspection shall be in accordance with ASTM designation E109-57T.

(*c*) Where more than one casting of a particular design is produced, each of the first five castings shall be inspected as above. Where more than five castings are being produced, the examination shall be performed on the first five plus one additional casting to represent each five additional castings. If this additional casting proves to be unacceptable each of the remaining castings in the group must be inspected.

(*d*) Any discontinuities in excess of the maximum permitted in Pars. (1)(a) and (1)(b) shall be removed and the casting may be repaired by welding after the base metal has been inspected to assure complete removal of discontinuities. The completed repair shall be subject to re-inspection by the same method as was used in the original inspection and the repaired casting shall be stress-relieved.

(*e*) All welding shall be performed using welding procedure qualification in accordance with Section IX. The procedure qualification shall be performed on test specimen of cast material of the same specification and subjected to the heat-treatment before and after welding as will be applied to the work. All welders and operators performing this welding shall also be qualified in accordance with Section IX.

2 All steel castings having a body greater than 4 in. nominal thickness shall be inspected as follows:

(*a*) Each casting shall be subjected to 100 per cent visual and magnetic particle inspection of all surfaces after heat-treatment. In the case of non-magnetic materials, penetrant oil and powder methods shall be used. All Type I indications of ASTM designation E 125-56T and all

indications exceeding Degree I of Types II, III, IV and V shall be removed. The inspection technique shall be in accordance with ASTM designation: E109-57T.

(*b*) All parts of castings shall be subjected to complete radiographic inspection and the radiographs shall conform to the requirements of ASTM Specification E 71-52, "Industrial Radiographic Standards for Steel Castings," Class 2.

(*c*) Any discontinuities in excess of the maximum permitted in Pars. (2)(a) and (2)(b) shall be removed and may be repaired by welding after the base metal has been magnetic particle inspected to assure complete removal of discontinuities.

(*d*) All weld repairs of depth exceeding 1 inch or 20 per cent of the section thickness, whichever is the lesser, shall be inspected by radiography in accordance with Par. (2)(b) and by magnetic particle inspection of the finished weld surface. All weld repairs of depth less than 20 per cent of the section thickness, or 1 in., whichever is the lesser, and all weld repairs of sections which cannot be effectively radiographed shall be examined by magnetic particle inspection of the first layer, of each $^1/_4$ in. thickness of deposited weld metal and of the finished weld surface. Weld repairs resulting from the ultrasonic inspection shall be inspected by the same method. Magnetic particle testing of the finished weld surface shall be done after stress-relieving.

(*e*) When repair welding is done after heat-treatment of the casting, the casting shall be stress-relieved.

(*f*) All welding shall be performed using welding procedure qualification in accordance with Section IX. The procedure qualification shall be performed on test specimen of cast material of the same specification and subjected to the heat-treatment before and after welding as will be applied to the work. All welders and operators performing this welding shall also be qualified in accordance with Section IX.

3 Identification and Marking. Each casting shall be marked with the manufacturer's name and the casting identification, including the applicable casting quality factor and material designation. The manufacturer shall furnish reports of the chemical and mechanical properties and certification that each casting conforms to all the applicable requirements.

PARS. A-130 thru A-133. Delete these paragraphs

Heating Boilers, 1959

PAR. H-5(a), revise second sentence to read:

Except as otherwise specified herein, materials used in the construction of steel heating boilers shall be those specifically provided for corresponding applications in the construction of power boilers.

PAR. H-43(a), add the following as a new sentence:

Each valve which does not permit gravitational draining at the outlet shall have one or more open gravity drains through the casing below the level of the valve seat. For iron and steel bodied valves exceeding 2 in. pipe size, the drain hole or holes shall be tapped not less than $^3/_8$ in. pipe size.

PAR. H-63, revise the third sentence to read:

No outlet connections, except for damper regulator, feedwater regulator, steam gages or apparatus which does not permit the escape of any steam or water therefrom except for manually operated blow downs shall be attached to a water column or the piping connecting a water column to a boiler (see PAR. H-38 for introduction of feedwater into boiler).

PAR. H-96(a), revise to read as given in PAR. H-43(a).

PAR. H-116, revise to read as given in PAR. H-63.

Unfired Pressure Vessels, 1959

PAR. UG-9(b), revise as follows:

Integrally finned tubes may be made from tubes that conform in every respect with one of the specifications given in Section II except that the pressure test is not required. These tubes may be used under the following conditions:

PAR. UG-9(b)(5), revise as follows:

In addition to the tests required by the governing specifications (except pressure tests) each tube after finning shall withstand without evidence of leakage, an integral pneumatic test of not less than 250 psi for 5 seconds while immersed in water or other suitable liquid.

PAR. UG-24 Castings, revise present paragraph to read:

(*a*) Quality Factors—A casting quality factor as specified below shall be applied to the allowable stress values for cast materials given in Subsection C except for cast iron. Definitions and radiographic standards are given in Appendix VII.

(1) A factor not to exceed 80 per cent shall be applied when a casting is inspected only in accordance with the minimum requirements of the specification for the material.

(2) For nonferrous and nodular cast iron materials a factor not to exceed 90 per cent shall be applied if in addition to the minimum requirements of the specification:

(*a*) Each casting is subjected to a thorough inspection of all surfaces, particularly such as are exposed by machining or drilling, without revealing any injurious defects;

(*b*) At least three pilot castings[4] representing the first lot of five castings made from a new or altered design are sectioned or radiographed at all critical sections (see Note 1 Appendix VII) without revealing any injurious defects;

(*c*) One additional casting taken at random from every subsequent lot of five is sectioned or radiographed at all critical sections without revealing any injurious defects; and

(*d*) All castings other than those which have been radiographed are examined at all critical sections by a procedure using magnetic particles per Appendix VI or liquid penetrant or by grinding or machining and etching.

3 For nonferrous and nodular cast iron materials a factor not to exceed 90 per cent may be used for a single casting which has been radiographed at all critical sections and found free of injurious defects.

4 For nonferrous and nodular cast iron materials a factor not to exceed 90 per cent may be used for a casting which has been machined to the extent that all critical sections are exposed for inspection for the full wall thickness; as in tube sheets drilled with holes spaced no farther apart than the wall thickness of the casting. The inspection afforded may be taken in lieu of destructive or radiographic testing required in (2)(b).

5 For carbon, low alloy, or high alloy steels a factor not to exceed 100 per cent may be applied if in addition to the minimum requirements of the specification the inspection and testing requirements of Appendix VII are met.

(*b*) Defects—Serious defects shall be the basis for rejection of the casting. The inspector shall have the right to demand a similar inspection of any number of additional castings from the same heat until acceptable castings are consistently produced where a 90 or 100 per cent quality factor is used. Where defects not impairing the strength of the casting have been repaired by welding, the completed repair shall be subject to reinspection, and to obtain a 90 or 100 per cent factor, the repaired casting shall be stress-relieved.

(*c*) Identification and Marking—Castings to which a quality factor of 90 or 100 per cent is to be applied shall be marked with the manufacturer's and materials identification marking and in

addition, the quality factor shall be clearly stamped on the casting. Test reports or certificates furnished by the manufacturer shall certify that the castings conform to the requirements of the Code.

Note 4: Pilot Castings—Any one casting, usually one of the first from a new pattern, poured of the same material and using the identical foundry procedure (risering, gating, pouring and melting) as the castings it is intended to represent. Any pilot casting or castings taken to represent a lot and the castings of that lot shall be poured from a heat of metal from which the castings on the current order are poured.

Par. UW-50, revise the last two lines to read as follows:

. . . by magnetic particle inspection per Appendix VI when the material is ferromagnetic or by liquid penetrant when the material is non-magnetic.

Par. UF-31(b)(1)(a), revise paragraph to read as follows:

(a) After final heat-treatment, such vessels shall be examined for the presence of cracks on the outside surface of the shell portion and on the inside surface where practicable. This examination shall be made by liquid penetrant when the material is nonmagnetic and by magnetic particle inspection per Appendix VI when the material is ferromagnetic.

Par. UF-32(c)(4), revise paragraph to read as follows:

(4) The finished welds shall be examined after final heat-treatment or stress-relief by liquid penetrant when the material is nonmagnetic and by magnetic particle inspection when the material is ferromagnetic using the Prod Method of Appendix VI.

Par. UF-37(b)(1)(c), line five, revise to read as follows:

. . . materials requiring stress-relief shall be examined by radiographing, magnetic particle inspection per Appendix VI or any alternative method suitable for determining cracks.

Par. UF-37(b)(2)(a), in the next-to-last line, revise dye penetrant to liquid penetrant.

Also at the end of this paragraph add the following sentence:

When magnetic particle inspection is employed, it shall be per Appendix VI.

Par. UF-37(b)(2)(b), revise this paragraph to read as follows:

(*b*) Welding repairs on materials which are to be or have been liquid quenched and tempered, regardless of depth or area of repairs, shall have the repaired area radiographed and examined by magnetic particle inspection per Appendix VI.

Par. UCS-6, Add a new subparagraph as follows:

(*c*) Steel plate conforming to specification SA-433 may be used for pressure parts in unfired pressure vessels provided all the following requirements are met:

1 The maximum allowable stress values between −20 and 550 F shall be one-fourth of the minimum specified tensile strength shown in Table UCS-23.

2 The maximum thickness of welds shall be 2 in.

3 Overlay or joining by welding of these materials with stainless steels or other high alloys is prohibited. These materials shall be welded only with carbon steel filler materials.

Par. UCS-27(a) and (b), in the fifth line after open-hearth, add basic oxygen.

Table UCS-23, under the heading Carbon Steel Plate, add as follows:

Plate Steels Carbon Steel	Grade	Nominal Composition	P-number	Specified Minimum Tensile	Notes
SA-433	L-45	1/4 Pb	1	45,000	(25)
SA-433	L-50	1/4 Pb	1	50,000	(25)
SA-433	L-55	1/4 Pb	1	55,000	(25)
SA-433	LK-55	1/4 Pb C-Si	1	55,000	(25)
SA-433	LK-60	1/4 Pb C-Si	1	60,000	(25)
SA-433	LK-65	1/4 Pb C-Si	1	65,000	(25)
SA-433	LK-70	1/4 Pb C-Si	1	70,000	(25)

Add new Note (25) to read:

Note (25) See Par. UCS-6(c)

Table UNF-23, under Copper and Copper Alloys, revise Note 2 as follows:

To these stress values a quality factor as specified in Par. UG-24 shall be applied.

Par. UHA-8, add as a new paragraph as follows:

(*a*) Approved specifications for castings of high alloy steel are given in Table UHA-23 together with a tabulation of allowable stress values at different temperatures. These stress values are to be multiplied by the casting quality factors of Par. UG-24. Castings that are to be welded shall be of weldable grade.

(*b*) Cast high alloy steel flanges and fittings complying with ASA B16.5-1957 shall be used within the ratings assigned in these standards.

Par. UHA-51(a), revise to read as follows:

For Types 304, 304L and 347 at operating temperatures below −425 F and all other materials below −325 F.

Par. UCI-3(c), revise to read:

Cast iron flanges and flanged fittings conforming to ASA B16.1-1960 Cast Iron Pipe Flanges and Flanged Fittings, Class 125 in sizes to 12 inch, inclusive, and ASA B16.2-1960, Cast Iron Pipe Flanges and Flanged Fittings, Class 250 may be used in whole or in part of a pressure vessel for pressures not exceeding the ASA ratings at temperatures not exceeding 450 F.

Par. UCI-35(b)(3), revise first sentence to read as follows:

Cast iron flanges and flanged fittings conforming to ASA B16.1-1960 Cast Iron Pipe Flanges and Flanged Fittings, Class 125 in sizes to 12 inch inclusive, and ASA B16.2-1960, Cast Iron Pipe Flanges and Flanged Fittings, Class 250 may be used in whole or in part of a pressure vessel for pressures not exceeding the ASA ratings at temperatures not exceeding 450 F.

Table UCN-23, add a Note column and a reference note (1) for specification SA-395. Also add definition of Note (1) to read:

(1) To these stress values, a quality factor as specified in Par. UG-24 shall be applied.

Par. UA-7, second paragraph, revise phrase beginning with magnetic particle, as follows: . . .; when radiographic examination of welds is not practicable, liquid penetrant examination may be used with non-magnetic materials and either liquid penetrant or magnetic particle inspection with ferro-magnetic materials. If magnetic particle inspection is employed, the Prod Method of Appendix VI is preferred.

Table UA-47.1 (Now Table UA-49.1) Gasket Materials and Contact Facings. These revisions may be obtained from the Secretary of the ASME Boiler and Pressure Vessel Code, United Engineering Center, 345 East 47th Street, New York 17, N. Y.

Table UA-47.2 (Now Table UA-49.2) Effective Gasket Width. These revisions may be obtained from the Secretary of the ASME Boiler and Pressure Vessel Code, United Engineering Center, 345 East 47th Street, New York 17, N. Y.

Appendix VI, Methods for Magnetic Particle Inspection, add as new appendix. Copy available from the Secretary of the ASME Boiler and Pressure Vessel Code, United Engineering Center, 345 East 47th Street, New York 17, N. Y.

Appendix VII, Inspection and Testing of Steel Castings, add as new appendix. Copy available from the Secretary of the ASME Boiler and Pressure Vessel Code, United Engineering Center, 345 East 47th Street, New York 17, N. Y.

Appendix N, Steel Castings Inspection for Higher Quality Factor, delete.

Appendix O, Cast-Iron Flanges and Flanged Fittings, delete.

Current Engineering Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

Draft Deferment Program Announced by Manpower Commissions

Employer's Inventory May Prevent Technical Manpower Shortage

Employers of engineering and scientific manpower may now evaluate it with an eye toward safeguarding its most effective utilization in the event of a sudden increase in the military draft.

The Employer's Inventory of Critical Manpower, a plan developed by the Engineering Manpower Commission of Engineers Joint Council and the Scientific Manpower Commission, will enable employers to analyze their own manpower situations in the light of the latest Selective Service and military reserve regulations.

"Present safeguards are inadequate to prevent the wholesale withdrawal of engineering and scientific manpower from industry in a national emergency," said Dr. Sydney B. Ingram, chairman of the Engineering Manpower Commission. The program was announced jointly by Dr. Ingram and Colonel Daniel O. Omer, Deputy Director of Selective Service.

Dr. Ingram said, "We view with deepest concern present inadequate provisions to prevent wholesale disruption of essential production and the slowing down of the rate of technological advance in the event of a sudden and substantial mobilization."

The inventory program, which has been endorsed by the Director of Selective Service, will work in the following way:

The employer will distribute to each of his male employees Form I of the Employer's Inventory of Critical Manpower. The completed form will contain a record of each man's reserve status plus the name and description of his job and his educational background.

From the information on Form I, each employee will be assigned a letter (A through M), which is his Designation of Probable Liability. Using these designation letters and a series of key box numbers, the employer may complete Form II, the Inventory Chart. By inspection, this second form will answer such questions as: How many employees in the critical group of draft age are vulnerable for military service and what is the degree of such vulnerability? Which activities in your company, essential or nonessential, have the greater number of vulnerable critical employees? Are there enough men in the less vulnerable categories to fill in for possible loss of those in the highly vulnerable categories?

Upon completing the Inventory Chart, the employer will send it to the Director of Selective Service in his state, thus making the Selective Service System aware of the employer's manpower inventory.

Occupations and activities designated critical and essential by the U. S. Department of Labor are made available to the Selective Service System for use in occupational deferment.

Critical occupations include professional engineers in all branches, aircraft and engine mechanics, chemists, die setters, electronic technicians, engineering draftsmen, instrument repairmen, jig-and-template makers, machinists, and tool and die designers and makers. Teachers, apprentices, and foremen in these and other critical occupations also listed by the Department of Labor are included.

Essential activities are the production and maintenance of aircraft and parts, ship and boat engineering, ordnance, production of electronics and communication equipment, production of chemical and allied products, and research and development services, among others.

A man receives his Designation of Probable Liability, expressed by the letters A through M, according to his involvement in a critical occupation and/or essential activity in combination with other reasons for deferment.

For instance, Group A designates men who are ready reservists, immediately available for military service. Men of the ages 19 through 25 engaged in a critical occupation but in a nonessential activity are in Group B. These men, however, presumably could qualify for occupational deferment with a move to an essential activity. Men of ages 19 through 25 who are not living with children, and who are engaged in a critical occupation and an essential activity are placed in Group K near the bottom of the scale. Men in this category and in category K+ (critical occupation and essential activity plus other reasons for deferment), are the least vulnerable in the event of a draft increase.

"Although Selective Service calls are building up rapidly," said Dr. Ingram, "present conditions make it possible to fill them without seriously affecting deferments for engineers and scientists, but without prior planning and full information, there may not be time to identify men whose skills and occupations are critical. The Employer's Inventory of Critical Manpower, developed by the two Manpower Commissions, provides a means by which employers can be informed currently as to their own status, and through which employers can easily make available such information to Selective Service."

Forms and current information on the draft are being supplied by the Engineering and Scientific Manpower Commissions. The Engineering Manpower Commission is located with Engineers Joint Council in the United Engineering Center, 345 E. 47th Street, New York 17, N. Y.

46th National Conference on Weights and Measures Takes Action on Resolutions

NEARLY 400 delegates attended the 46th National Conference on Weights and Measures, June 12–16, in Washington, D. C., with weights and measures officials representing 35 States, the District of Columbia, and the Commonwealth of Puerto Rico. Also represented were the Institute of Weights and Measures Administration of Great Britain, and the Standards Division of the Department of Trade and Commerce of Canada.

Resolutions. Several resolutions were among the principal actions of the Conference, which is sponsored by the National Bureau of Standards in co-operation with weights and measures officials throughout the United States. One resolution commended President Kennedy for his intention to establish a consumer counsel in the President's office, and offered the full co-operation of the National Conference on Weights and Measures. Another resolution urged that manufacturers, packers, and advertising agencies study and survey possible areas of deceptive packaging and labeling to assure adherence to existing laws, regulations, and moral obligations.

Seek Equity in Commercial Transactions. Speaking at the opening session, Secretary of Commerce Luther H. Hodges cited the long successful relationship of NBS and the National Conference, and their mutual efforts to insure "that equity may prevail" in the Nation's commercial transactions. The Secretary noted the increased efforts of the Bureau to extend and refine the standards of physical measurement, citing the importance of such efforts to the country's economic progress, to its military and space programs, as well as to the advancement of science itself.

Referring to the wide technical activities of the Department of Commerce, Secretary Hodges said, "We have asked the Congress to authorize a new Assistant Secretary of Commerce for Science and Technology to help us make the most intelligent use of Commerce's various technical agencies, and to work with other government agencies and private industry to achieve more fully the benefits that can be derived from an estimated $14 billion now being spent annually for research and development. We believe Congress will grant our request."

An address by Senator Philip A. Hart of Michigan highlighted the Conference luncheon on June 14. The Senator discussed the hearings which the Senate antitrust and monopoly subcommittee is conducting on deceptive practices in packaging and labeling. Senator Hart declared that such practices could threaten the very preservation of our free enterprise economy.

Measurement. NBS Director A. V. Astin, president of the National Conference, addressing the Conference on June 13, reviewed recent technical achievements of the Bureau in the field of measurement, giving particular attention to accomplishments of significance to the weights and measures field.

One high light of the Conference was an address by J. R. Roberts, Chief Inspector of Weights and Measures, Manchester, England, and Secretary, The (British) Institute of Weights and Measures Administration. Mr. Roberts described the apprenticeship, training and education, and examination which in Great Britain lead up to the certification and status of a weights and measures official.

A. E. Diaz, Head of the Weights and Measures Division, Economic Stabilization Administration, Commonwealth of Puerto Rico, reported on a one-year Central American study which he recently concluded as a representative of the Technical Assistant program of the United Nations. The purpose of the study was to set up weights and measures control programs in Central America on national bases, and to encourage the establishment of a Central American Research Institute for Industry at Guatemala City, which would supply standards and technical assistance to the national bureaus. The standardization of weights and measures in Central America has been considered of paramount importance as part of the preparations for the Common Market, under the Economic Integration Program.

W. S. Bussey of NBS, reporting as Secretary of the National Conference, summarized weights and measures activities of the States, counties, and cities, and at the National Bureau of Standards. Complete new weights and measures laws were enacted during the past year by Alaska and Tennessee, Mr. Bussey reported, and numerous amendments to standing laws were enacted by several other States. The technical training for weights and measures officials, conducted by the NBS Office of Weights and Measures, was described.

The Conference, which was organized in 1905, is sponsored by the National Bureau of Standards and brings together weights and measures officials, as well as representatives of business and industry.

Model laws, specifications, tolerances, regulations, as well as enforcement practices are recommended by the Conference for adoption by the various States, which have the legal responsibility of regulating commercial weighing and measuring devices, and of controlling commercial transactions involving quantity. The Bureau, through its Office of Weights and Measures, cooperates with the States in this endeavor by providing reference standards, calibrating services, and a wide range of technical advisory programs. Thus the national standards of length and mass, which are in the custody of the Bureau, are translated into everyday use.

PEOPLE

Honors and Awards. I. MELVILLE STEIN, Fellow ASME, president of Leeds & Northrup Company, Philadelphia, Pa., became a Lifetime Honorary Member of the Instrument Society of America on September 13 during its annual meeting in Los Angeles, Calif. The society's highest award, it was conferred on Dr. Stein for contributions in the art and science of automation. He is the ninth man so honored by the society since its founding in 1946.

Also recognized at the ISA annual meeting were two ASME Members, GLENN F. BROCKETT, Marshalltown, Iowa, and WERNER G. HOLZBOCK, Bloomfield Hills, Mich., who were made fellows of the society for their distinguished contributions to the art of instrumentation.

CHARLES W. TRINKS, Fellow ASME, internationally known engineer and professor-emeritus of Carnegie Tech, recently was honored with the presentation of a plaque dubbing him "an outstanding citizen, engineer, and educator" by the Fayette Chapter of the Pennsylvania Society of Professional Engineers. Shortly before he received this honor, the Producers Council, Inc., Pittsburgh Chapter, enrolled the professor's name in the Hall of Fame as a consulting and professional engineer.

Martin Goland, Mem. ASME, and member of the ASME Publications Committee, si recognized as one of the South's progressive leaders in the 1961 edition of "The Blue Book of Southern Progress." Mr. Goland, 41, is president and director of the Southwest Research Institute, San Antonio, Texas, and chairman of the Research Advisory Committee on Aircraft Structures of the National Aeronautics and Space Administration. He is on the advisory panel of the Committee on Science and Astronautics, U. S. House of Representatives, and a member of the Brittle Fracture Committee, National Research Council. He holds patents on automatic measuring apparatus and methods, and has authored numerous publications in the engineering sciences.

Also to be listed in the "Blue Book" is Edwin Davies Harrison, Mem ASME. Dr. Harrison is president of the Georgia Institute of Technology, Atlanta, Ga. The Blue Book list of progressive leadership was compiled after more than 300 prominent Southerners representing a cross section of the economy were asked to name their choice of the men who best represented the South's new leadership.

New Officers. Philip T. Sprague, Mem. ASME, assumed the presidency of the Instrument Society of America on September 12 in conjunction with the society's annual meeting at the Biltmore Hotel, Los Angeles, Calif. Mr. Sprague, who just completed a year as ISA's president-elect-secretary, is president of The Hays Corporation, Michigan City, Ind.

William H. Pickering has been elected president of The American Rocket Society. He will take office on Jan. 1, 1962. Dr. Pickering is director of the Jet Propulsion Laboratory operated in Los Angeles, Calif., by the California Institute of Technology for the National Aeronautics and Space Administration.

Aaron Finerman, manager of Republic Aviation Corporation's Digital Computing and Data Processing Division, is the new president of the SHARE Organization. Composed of users of large scale IBM computers, the organization promotes the free interchange of information concerning the use of such equipment.

Appointments. V. Lawrence Parsegian, Mem. ASME, has been appointed to the new chair of Rensselaer Professor at Rensselaer Polytechnic Institute, where he has been dean of the school of engineering and professor of nuclear engineering.

Robert W. Ritzmann, nuclear engineer, was appointed the Atomic Energy Commission's scientific representative at Chalk River, Ont., Canada, effective September 3. He will provide liaison between the AEC and the Canadian atomic energy program. Previously, he was chief of the Planning Section in the Evaluation and Planning Branch of AEC's Division of Reactor Development.

Vannevar Bush, Hon. Mem. ASME, is chairman of the National Sponsoring Committee for the celebration of the 125th anniversary of the American Patent System.

The committee, drawn from leaders in the engineering, scientific, industrial, legal, and legislative fields, is organized to sponsor appropriate observances this year of the 125th anniversary of the Patent Act of 1836. The celebration was highlighted by a special three-day program in Washington, D. C., during the week of October 15–21, which President Kennedy proclaimed as American Patent System Week.

Members of ASME on the committee include: William H. Byrne, President and Fellow, ASME; Detlev W. Bronk, Hon. Mem. ASME; and Walker L. Cisler, past-president and Fellow ASME.

EDUCATION

Steam Lab

A steam laboratory demonstration unit is now available for college engineering students. Designed to meet a need for smaller, more compact equipment for the laboratory and lecture room, the unit demonstrates the application of thermodynamic principles involved in steam turbines used for electric power generation. Among the characteristics that can be shown are efficiency, flow-load performance, and the effects of inlet

Just prior to the dedication ceremony for the recently completed School of Engineering Building of The Cooper Union, Friday morning, Sept. 15, 1961, former President Herbert Hoover, Hon. Mem. ASME, **third from left,** chats with, **left to right,** President Richard F. Humphreys of The Cooper Union, President Richard G. Folsom, Fellow ASME, of Rensselaer Polytechnic Institute, and Irving S. Olds, chairman of The Cooper Union trustees. Mr. Hoover was honorary chairman of The Cooper Union Centennial Committee, which helped raise funds for the new building. President Folsom was principal speaker at the dedication service. (See editorial, p. 41.)

At 23,000 ft over central Indiana, this DC-6 is helping to educate more than one million students by transmitting a TV signal reaching into six Midwestern states within a 200-mile radius. The students began receiving televised instruction on September 11 on a program series scheduled to run until late May, 1962. The programs trace back to a system known as Stratovision, conceived and developed by Westinghouse engineers. The education project was undertaken by the Midwest Program on Airborne Television Instruction and will link a potential 13,000 classrooms into a network offering instruction from the first grade level through collegiate courses. Aboard the plane, an engineer and two technicians operate tape recorders and monitor picture and sound output for two channels telecast simultaneously.

pressure-temperature and back pressure variations.

The key component of the unit is a turbine-generator set consisting of a 3750-rpm, 110-volt, d-c generator driven by a single-stage two-row, impulse-type steam turbine. The generator is self-excited and has a compound wound field. Other major components of the unit are a four pass surface condenser with extra large hot well, an electric condensate pump, an air ejector, an electric steam superheater and associated controls, and a power panel. Various measuring devices also are furnished with the unit. The unit measures $5^{11}/_{12}$ ft long, $3^{2}/_{3}$ ft wide, and $5^{7}/_{12}$ ft high, weighs about 1650 lb, and can easily be moved. The University of Pennsylvania is the first to receive one of the units. They are being produced by Westinghouse Electric Corporation.

Awards

A CLOSING date of November 16, 1961, has been announced for proposals regarding the design and development of prototypes of new laboratory equipment for school and college courses in mathematics, engineering, and science. The date for receipt of the proposals was set by the Division of Scientific Personnel and Education of the National Science Foundation.

Awards will be announced in March, 1961. Inquiries should be addressed to the division at the National Science Foundation, Washington 25, D. C.

Atomic Age Welding Conference Includes Space Technology

FIFTY leaders in the field of welding engineering met in San Antonio, Texas, Sept. 20–22, 1961, for the annual AEC Welding Forum. The meeting was sponsored by the U. S. Atomic Energy Commission. Arrangements were by Southwest Research Institute.

An annual meeting since 1950, the Welding Forum provides a vehicle for discussion of problems encountered both in governmental and industrial welding construction and research. Chairman of the meeting was Frank W. Davis, Mem. ASME, of Southwest Research Institute.

Among papers presented at the meeting were reports on fabrication of zirconium end pads to fuel elements, methods of reducing molten metal/weld metal temperature variation in A-C welding, and a report on braze-welding of beryllium.

At the close of the meeting in San Antonio, members of the forum traveled to Monterrey, Mexico, where they inspected facilities of the Instituto de Investigaciones Industriales, a not-for-profit research organization there. It is affiliated with the Instituto Tecnologico y de Estudios Superiores de Monterrey and with SwRI in San Antonio. They also inspected the steel plant of Hojalata y Lamina and the Escuela de Soldadura, a welding school in Monterrey.

Designing for Nonmetallics Symposium

A SYMPOSIUM, "Designing for Nonmetallics," will be held at the University of New Mexico, November 17 and 18, 1961. Under the sponsorship of the New Mexico section of ASME and the University of New Mexico, the symposium will be chaired by C. L. Carpenter, of the Sandia Corporation.

The technical program includes a welcoming address by Dr. Richard H. Clough, Dean of the college of Engineering, UNM; and technical papers on the following subjects: an introduction to designing with plastics, structural laminates, filament winding, glass and ceramics, encapsulation, and ablative materials.

The committee has also arranged a guided tour of Sandia Corporation's Nonmetallic Laboratory and Sphere of Science.

MEETINGS OF OTHER SOCIETIES

• IN THE UNITED STATES

November 15–17

AMA, Conference and Exhibit on Programmed Learning and Teaching Machines, Ambassador Hotel, Los Angeles, Calif.

November 27–December 1

Exposition of Chemical Industries, New York Coliseum, New York, N. Y.

November 28–30

Building Research Institute, 1961 fall conference, Design for the Nuclear Age, Mayflower Hotel, Washington, D. C.

December 3–7

AIChE, annual meeting, Commodore Hotel, New York, N. Y.

December 4–5

Conference on beryllium metallurgy, sponsored by the Beryllium Corporation of America and the Brush Beryllium Company, New York University's Washington Square Center, New York, N. Y.

• IN EUROPE

November 7–12

Third Conference and Exhibit on Automation and Instrumentation, sponsored by the Consiglio Nazionale delle Ricerche, Milan, Italy.

November 13–16

National Maintenance Conference and Exhibition, organized by *Plant and Factory Maintenance*, to be held at The Central Hall, Westminster, London, England.

November 16–25

Hungarian Scientific Society for Mechanical Engineering, international festival of scientific and technical films for mechanical engineering, Budapest, Hungary.

• IN JAPAN

November 6–11

Society of Chemical Engineers, Japan, 25th anniversary congress exhibition, Sankei Hall, Tokyo, Japan.

(*For ASME Coming Events, see page 121.*)

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

A LOOK AT

There is health in newness, an American kind of health that disdains the comfortable rut, the clinging to the past. The pictures on these pages display the surface indications of the health and vitality of your professional society. In its new, streamlined offices in the United Engineering Center, at New York's United Nations Plaza, The American Society of Mechanical Engineers has established a Headquarters plant that provides the latest facilities engineers have devised for swift, efficient office procedures. The forward-looking men who founded ASME in 1880 would be well pleased.

Reception. When you visit Headquarters, you will first see this reception room on the 6th floor. If you have a moment: That picture behind the desk is a self-portrait by Robert Fulton, an engineer of many interests. **President's Office.** Although ASME Presidents have rarely required permanent office space at Headquarters, the new executive suite includes a small, handsomely appointed office reserved for the President. On the wall behind President William H. Byrne is Ballin's portrait of John Ericsson, engineer and inventor.

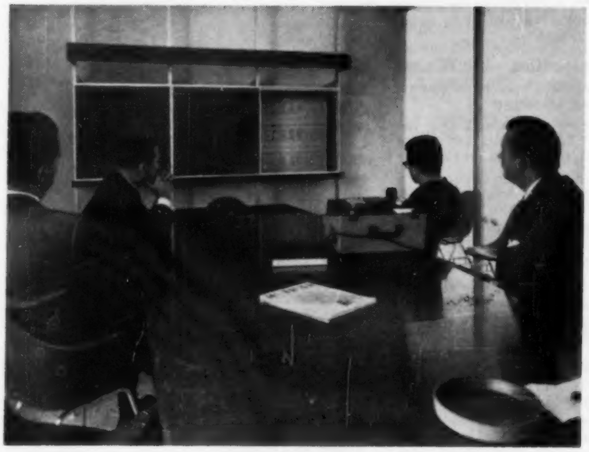
ASME HEADQUARTERS

Secretary's Office. In his spanking new office on the sixth floor, ASME Secretary O. B. Schier II, **right,** confers with Editor J. J. Jaklitsch, Jr. Roomier than the old office, there is also enough space to hold small conferences or meetings in comfortable surroundings.

Council Room. Named for the Council, the room provides a businesslike atmosphere for discussing ASME affairs. Shown is the Executive Committee of Council with President Byrne at head of the table. Other members, on President Byrne's **left,** include: H. N. Muller, D. E. Marlowe, L. N. Rowely, and R. B. Smith. Also in attendance: Finance Committee chairman E. J. Schwanhausser and Vice-President George B. Thom. Hanging on wall is an original portrait of Sir Isaac Newton.

Light and Airy. This describes ASME's three floors (5, 6, and 7). Ample light, both natural and fluorescent, make for pleasant working conditions. Plastics and metals predominate. With pleasing variations in color schemes, light vinyl desk tops, and new or repainted file cabinets, a clear uncluttered look has been achieved.

Magazines, Technical Papers, Books. On ASME's 5th floor, members will find Publication Sales. Here the Society maintains a stock of some 300 books, codes and standards, and other publications. In addition to MECHANICAL ENGINEERING, the five Transactions quarterlies, Mechanical Engineers' Catalog, and Applied Mechanics Reviews, ASME prepares more than 400,000 individual technical papers yearly.



Meeting Rooms. ASME's three meeting rooms on the 7th floor are named in honor of the Society's founders: Holley, Worthington, and Sweet. The operations of ASME are made possible by the committee work of the more than 5000 engineers whose industries and institutions back them in giving time and energy to the Society. Through their efforts, ASME serves the profession and the industry by holding meetings, publishing periodicals, formulating codes and standards.

Food Services. A 200-seat cafeteria is located on the ground floor. It looks out on a sunken, landscaped coutr. Climb the stairs to the lobby floor for additional dining facilities. Here meeting - dining rooms include one for 135 persons and two for 20.

Library. The Engineering Societies Library, located on the 2nd floor, has seating space for 80 readers. Bound volumes of engineering magazines are in stacks at one end of the room. A special reference "bar" is arranged for those using the various indexes. (See MECHANICAL ENGINEERING, Sept., 1961, pp. 52–54.)

Greatly Expanded Program Marks Second ASME Symposium on Thermophysical Properties to Be Held at Princeton University, Jan. 24–26, 1962

For the second time the Standing Committee on Thermophysical Properties of the ASME Heat Transfer Division is holding its own symposium. Encouraged by the response to the first symposium, held at Purdue University in February, 1959, the scope of the program has been greatly expanded, and participation from abroad has been multiplied. Princeton University has been chosen as the meeting place, and the Trenton Subsection of the Philadelphia Section of ASME will be the host.

Seventy papers will be presented in 13 sessions during the three-day meeting scheduled for Jan. 24–26, 1962. The symposium will have a strong international character, in as much as half of the papers are by authors from the United Kingdom, Germany, France, Holland, Switzerland, Italy, Japan, and Australia. A glance at the program will show that many of the world-famous institutes are represented with contributions, and some of the leading authorities are among their authors.

The program is designed not only to those engaged in research on thermophysical properties, but to the ever-increasing number of engineers whose work requires of them to get acquainted with this field. Therefore a special feature of the symposium is the review papers which serve as introductions to various specialized aspects of this field of thermodynamics.

Each day's work begins with a general lecture, followed by two simultaneous sessions. On Friday morning, outstanding papers on intermolecular forces are to be presented in a plenum session. Each afternoon is devoted to divided sessions, as is the first evening. Both theoretical and experimental research is equally represented; the growing interest of mechanical engineers in non-Newtonian fluids is reflected in a seven-paper session.

▶WEDNESDAY, JANUARY 24

Opening Address 9:00 a.m.

General Lecture 1 9:15 a.m.

Some recent advances in gas-transport theory. (Thermal diffusion in dusty and in ionized gases, and thermal conduction in plasmas in magnetic fields.) By Sidney Chapman, Univ. of Alaska, College, Alaska; and High Altitude Observatory, Boulder, Colo.

Ionized Gases 10:15 a.m.

Temperature Distribution in an Electric Arc, Burning in Hydrocarbon Vapor and Nitrogen, by H. Kroepelin and D. Kipping, Technische Hochschule Braunschweig, Germany

Electrical and Thermal Conductivity of Argon Plasma, by W. Springe, Technische Hochschule, Stuttgart, Germany

Equilibria in the Systems $C + H_2 + N_2$ and $C + H_2 + NH_3$ at Temperatures From 1000 K to 12000 K, by H. Kroepelin, D. Kipping, and H. Pietruck, Technische Hochschule, Braunschweig, Germany

Radiation Processes in a Plasma at High Temperatures, by Taro Kihara, Univ. of Tokyo, Japan

Cerenkov and Cyclotron Radiation in Plasmas, by Taro Kohara, Osamu Aono, and Ryo Sugihara, Univ. of Tokyo, Japan

Thermodynamic Properties 10:15 a.m.

The Constant Volume Heat Capacity of Gases, by J. J. Martin, Univ. of Michigan

Heat Capacity of Saturated Dissociating Vapors and the Form of Their Saturation Vapor Pressure Curves, by P. Gray, Univ. of Leeds

Volumetric Behavior of Hydrogen Chloride, by W. Thomas, Physikalisch Technische Bundesanstalt, Braunschweig, Germany

High-Temperature Thermal Property Measurements to 5000 F, by D. S. Neel and C. D. Pears, Southern Research Inst.

The Lewis Number, by R. S. Brokaw, NASA, Cleveland, Ohio

Transport Properties—Theoretical 2:15 p.m.

A Method of Calculating the Viscosity of Polar Gases, by J. R. Sutton, National Engineering Lab, Glasgow, Scotland

Survey of Recent Work on the Viscosity, Thermal Conductivity, and Diffusion of Gases and Liquefied Gases Below 500 K, by P. E. Liley, Thermophysical Properties Research Center, Purdue Univ.

Diffusion, Viscosity, and Thermal Conductivity of Gases, by Leonid Andrussow, Paris, France

Correlations for the Transport Properties of Pure Gaseous and Liquid Substances, by G. Thodos and L. I. Still, Northwestern Univ.

Armco Iron as a Thermal Conductivity Standard. Part 1. Review of Published Data, by R. W. Powell, M. H. Hickman, R. P. Tye, and Miss M. J. Woodman, National Physics Lab, Teddington

Thermodynamic Equilibrium 2:15 p.m.

Heats of Formation of Inorganic Fluorine Compounds—Survey, by G. T. Armstrong and L. A. Krieger, NBS, Washington, D. C.

Phase Equilibria Liquid—Liquid, Liquid–Vapor and Solid–Solid in the Temperature Region Between −185 C to +600 C, by Wilhelm Jost, Univ. of Göttingen

Heat of Mixing of Solid Solutions: The Binary System Tetramethyl-Methane Tetrachloro-Methane, by E. F. Westrum, Jr., and Elfreda Chang, Univ. of Michigan, Ann Arbor, Mich.

Discussion of Error in the Calculation of Simultaneous Equilibria, by K. K. Neumann, Technische Hochschule Braunshcweig, Germany

The Solubility of Compressed Gases in Non-polar Liquids, by K. E. Weale and E. B. Graham, Imperial College, London, England

Some Considerations on the Determination of Thermodynamic Quantities of Gaseous Mixtures, by J. J. M. Beenakker and J. M. J. Coremans, Kamerlingh Onnes Lab, Leiden

Radiation 8:30 p.m.

Heated Cavity Reflectometer for Angular Reflectance Measurements, by R. V. Dunkle, Commonwealth Scientific and Industrial Research Organization, Australia; D. K. Edwards, J. T. Gier, K. E. Nelson, and R. D. Roddick, Univ. of California, Berkeley

Measurement of Radiation Properties of Solid Materials, by E. R. G. Eckert, Univ. of Minnesota

The Determination of the Emittance of Refractory Materials to 5000 F, by C. D. Pears, Southern Research Inst.

Calorimetric Determinations of Thermal Radiation Characteristics, by R. C. Gaumer and L. A. McKellar, Streed, Frame, Grammer, Lockheed Missile and Space Div.

Computational Methods 8:30 p.m.

Determination of Thermodynamic Properties by Direct Differentiation Techniques, by Fred Landis and Edwin Nilson, Pratt & Whitney, East Hartford, Conn.

Closed Form Exact Solution for the First Partial Derivatives of Concentrations of Chemically Reacting Mixtures in Equilibrium, Specific Heats, and Related Quantities, by A. R. Hochstim and Bruce Adams, Convair, San Diego, Calif.

Machine Computation of the Thermodynamic Properties of Freon-114, by N. H. Van Wie and R. A. Ebel, Union Carbide, Oak Ridge, Tenn.

The Thermodynamic and Electrical Properties of Dissociated Combustion Gases, by W. C. Moffatt, M.I.T.

▶THURSDAY, JANUARY 25

General Lecture 2 9:00 a.m.

Significant Aspects of Non-Newtonian Technology, by D. G. Thomas, Cambridge Univ.

Non-Newtonian Fluids 10:00 a.m.

Non-Newtonian Viscosities and the Equation of Motion, by W. R. Schowalter, Princeton Univ.

Elasticity in Steady Flow of Non-Newtonian Liquids, by W. Philippoff, Esso Research and Engineering Co.

Normal Stresses in Fluids: Methods of Measurement, Their Interpretation, and Quantitative Results, by J. L. White and A. B. Metzner, Univ. of Delaware

Energy Transfer to Non-Newtonian Fluids in Laminar Flow, by E. B. Christiansen and G. E. Jensen, Univ. of Utah

The Rheology of Polyelectrolytes, Part 2. Dependence of the Viscosity of Solutions of Poly (Acrylic Acid) on Molecular Weight, by J. G. Brodnyan and E. L. Kelley, Rohm and Haas, Philadelphia, Pa.

Transport Characteristics of Suspensions. Part 5. Application of Different Rheological Models to Flocculated Suspension Data, by D. G. Thomas, Cambridge Univ. Engineering Lab and Oak Ridge

The Kinetic Mechanism of Yield Value and Viscosity in Thixotropic Suspensions, by F. Schultz-Grunow, Technische Hochschule, Aachen, Germany

Experimental Techniques 1 10:00 a.m.

The Application of Frequency Response Analysis to Thermal Conductivity Measurements, by C. F. Bonilla and B. L. Tarmi, Columbia Univ.

High-Temperature Gas Thermal-Conductivity Measurement With the Line Source Technique, by A. A. Westenberg and Newman de Haas, Applied Physics Lab

Measurement of the Thermal Conductivities of Liquids by an Unsteady-State Method, by

Publication of Proceedings

The Proceedings of the 1962 Second Symposium on Thermophysical Properties will be available during and after the meeting. After the meeting copies can be obtained from ASME Order Department, United Engineering Center, 345 East 47th Street, New York 17, N. Y.

P. P. Grassmann, W. Straumann, and F. Widmer, Eidgenössische Technische Hochschule, Zürich, Switzerland

Measurements of the Thermal Conductivity of Metals at High Temperatures, by Karl-Heinz Bode, Physikalisch-Technische Bundesanstalt, Braunschweig, Germany

Powell Comparator Method for Determining Thermal Conductivities—Discussion, by D. C. Ginnings, NBS, Washington, D. C.

New Method for the Determination of Thermal Conductivities Between 1000 C and 3000 C, by M. Hoch, Univ. of Cincinnati

Critical Region **2:30 p.m.**

Gradients of Density of Fluids Near Their Critical State in the Field of Gravity, by Ernst Schmidt and K. Traube, Technische Hochschule, Munich, Germany

Thermal Conductivity of CO_2 in the Critical Region, by A. Michels and J. V. Sengers, Van der Waals Lab, Amsterdam, Holland

Critical Region Viscosity Behavior of Ethane, Propane, and N-Butane, by K. E. Starling, B. E. Eakin, R. T. Ellington, and J. P. Dolan, Inst. of Gas Tech.

Supercritical Hydrogen Chloride: Specific Heat up to 300 C and 300 Atm; PVT-Data up to 400 C and 2000 Atm, by E. U. Franck, M. Brose, and K. Mangold, Univ. of Göttingen

Experimental Techniques 2 **2:30 p.m.**

A Recording Dilatometer and Measurements of Thermal Expansion Coefficient of Polymethyl-Methacrylate Between 90 K and 273 K, by Joseph Raffino, Instituto Nazionale de Metrologia, Torino

Adiabatic Calorimeter for Precise Measurements of Specific Heats of Powders and Granular Materials (0 C to 500 C), by E. O. Schmidt, Bayer, Leverkusen, Germany, and W. Leidenfrost, Purdue Univ.

An Axial-Flowporous Plug Apparatus, Part 2, by R. Forslund and J. H. Potter, Stevens Inst. of Tech., Hoboken, N. J.

Some Recent Throttling Investigations, by J. H. Potter, Stevens Inst. of Tech.

▶FRIDAY, JANUARY 26

General Lecture 3 **9:00 a.m.**

Thermodynamic and Transport Properties of Liquids, by H. Eyring, D. Henderson, and T. Ree, Univ. of Utah

Intermolecular Forces and Interactions **10:00 a.m.**

Very Short Range Interactions Between (a) Hydrogen Atoms, (b) Helium Atoms, by R. A. Buckingham and D. M. Duparc, Univ. of London, England

The Virial Theorem, Its Generalizations and Applications, by J. O. Hirschfelder, Univ. of Wisconsin

Optical Properties in Molecular Interactions,[1] by B. Vodar and Vu Hai, Laboratoire des Hautes Pressions, Paris, France

PVT Relations and Intermolecular Potentials for Methane and Perfluormethane, by D. R. Douslin, U. S. Bureau of Mines, Bartlesville, Okla.

Intermolecular Potentials From Scattering Experiments: Results, Applications, and Limitations, by I. Amdur, M.I.T.

Statistical Theory of Surface Tension, by H. Eyring, S. Chang, I. Matzner, and T. Ree, Univ. of Utah

General Lecture 4 **2:30 p.m.**

Transport Processes in Dense Gases and Liquids, by Edward McLaughlin, Imperial College, London, England

[1] To be presented at meeting only—not to be printed in any form.

Equations of State **3:30 p.m.**

The Equation of State of an Ionized Gas, by D. P. Duclos and A. B. Cambel, Northwestern Univ.

Equations of State of Gases at High Temperatures and Pressures,[1] by J. Saurel, J. Laurent, and B. Vodar, Institut des Hautes Pressions, Paris, France

An Equation of State for Steam, by R. W. Bain, E. A. S. Paton, and A. S. Scrimgeour, National Engineering Lab, Glasgow, Scotland

An Equation of State for Calculating the Thermodynamic Properties of Helium at Low Temperatures, by R. D. McCarty and R. B. Stewart, Cryogeni Lab., NBS, Washington, D. C.

Transport Properties—Experimental **3:30 p.m.**

Heat Conductivity of Compressed Helium at Elevated Temperatures, by P. Johannin, M. Wilson, and B. Vodar, Institut des Hautes Pressions, Paris, France

Thermal Conductivity of Liquid and Gaseous Ammonia, Hans Ziebland and Derek P. Needham, Explosives R&D Establishment, Ministry of Aviation, Waltham Abbey, Essex, England

Thermal Conductivities and Wassiljewa Coefficients for Gaseous Mixtures, by P. Gray, Univ. of Leeds, and P. G. Wright, Queens College, Dundee

Measurement of the Viscosity of Nitrogen and Steam, by J. H. Whitelaw, Brown Univ., Providence, R. I.

Transport Properties of Binary Mixtures of Rare Gases, by E. Thornton, Gas Council, London, England

Armco Iron as a Thermal-Conductivity Standard. New Determinations at NPL, by R. W. Powell, M. J. Hickman, R. P. Tye, and Miss M. J. Woodman, National Physics Lab, Teddington

ASME COMING EVENTS

November 26–December 1, 1961

ASME Winter Annual Meeting, Statler Hilton Hotel, New York, N. Y.

January 24–26, 1962

ASME Second Symposium on Thermophysical Properties, Princeton University, Princeton, N. J.

March 4–8, 1962

ASME Gas Turbine-Process Industries Conference and Products Show, Shamrock Hilton Hotel, Houston, Texas

March 27–29, 1962

American Power Conference, Sherman Hotel, Chicago, Ill.

April 5–6, 1962

ASME-SAM Management Engineering Conference, Statler Hilton Hotel, New York, N. Y.

April 9–13, 1962

ASME Metals Engineering Division—AWS Conference, Sheraton Cleveland Hotel, Cleveland, Ohio

April 10–11, 1962

ASME-AIEE Railroad Conference, King Edward Hotel, Toronto, Canada

April 11–13, 1962

ASME Spring Textile Engineering Conference, N. C. State College, Raleigh, N. C.

April 15–19, 1962

ASME Oil and Gas Power Conference and Exhibit, Shoreham Hotel, Washington, D. C.

April 24–26, 1962

ASME Production Engineering Conference, the Van Curler Hotel, Schenectady, N. Y.

April 30–May 3, 1962

ASME Design Engineering Conference and Concurrent Show, Chicago Exposition Center, Chicago, Ill.

May 7–8, 1962

ASME Maintenance and Plant Engineering Conference, Royal Orleans Hotel, New Orleans, La.

May 21–23, 1962

ASME Hydraulic Conference, Bancroft Hotel, Worcester, Mass.

June 4–6, 1962

ASME Lubrication Symposium, Deauville Hotel, Miami Beach, Fla.

June 4–8, 1962

Nuclear Congress (Biennial), New York Coliseum, New York, N. Y.

June 5–7, 1962

ASME Fuels Symposium, Rutgers University, New Brunswick, N. J.

June 10–14, 1962

ASME Summer Annual Meeting, Chateau Frontenac, Quebec, Canada

June 18–21, 1962

Fourth U. S. Congress on Theoretical and Applied Mechanics, University of California, Berkeley, Calif.

June 26–28, 1962

ASME Aviation Conference, University of Maryland, Washington, D. C.

June 27–29, 1962

Joint Automation Control Conference, New York University, New York, N. Y.

August 5–8, 1962

AIChE-ASME Heat Transfer Conference and Exhibit, Shamrock Hilton Hotel, Houston, Texas

September 13–14, 1962

Joint Engineering Management Conference, Roosevelt Hotel, New Orleans, La.

(For Meetings of Other Societies, see page 115.)

Note: Persons wishing to prepare a paper for presentation at ASME National meetings or Division conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, United Engineering Center, 345 East 47th Street, New York 17, N. Y. Price to nonmembers, 50 cents; to ASME members, free. Also available on request is a "Schedule of Program Planning Dates for Meetings and Publication Deadline Dates." Ask for Form M&P 1315.

L. F. Urwick Refutes Government Agencies' Incompetence—Address Highlights Engineering Management Conference Luncheon

ASME-AMA Luncheon honors recipient of Henry Laurence Gantt Gold Medal for 1961

Some businessmen believe that government agencies are "necessarily incompetent and, therefore, the best we can do is oppose all government action." The belief does not fit the realities of the modern world, according to Lyndall F. Urwick, a distinguished English specialist in management. Mr Urwick, chairman of Urwick, Orr & Partners, Ltd., London, honorary life member, ASME and AMA, voiced his opinion at a luncheon during the ninth Annual Joint ASME-AMA Engineering Management Conference, September 15, in New York City.

Colonel Urwick received the Henry Laurence Gantt Medal for 1961 during the luncheon. Thus it was that he—for the first time since the medal was established in 1929—became the first citizen of another country to receive the award.

He said, "I do not count myself among those who are content to allow this problem to go by default. It is easy to be negative, to assume that government is necessarily incompetent and that, therefore, the best we can do is to oppose all government action to substitute competitive private enterprise wherever possible. But we live in a world which today has a population of some 2,500,000,000. By the end of the twentieth century, only 40 years away, that figure will be, at least, doubled. It may be trebled.

"This demographic explosion takes no account of political ideologies. It is, in fact, far more menacing than the physical, the nuclear, explosions which currently preoccupy so many minds. Whereas today the prosperous, technologically advanced countries contain about one third of the world population, in 40 years they will account for only a quarter or maybe a fifth. And this at the very moment when the peoples of the underdeveloped countries are becoming politically conscious and insistent that they shall have a share in the material well-being which technological progress makes possible.

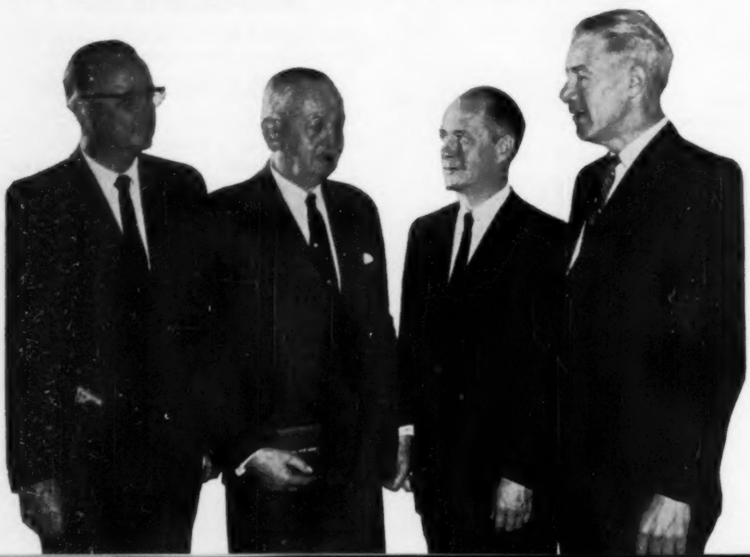
"Obviously," he added, "these facts raise issues far beyond the competence of any private organizations, indeed of any single national government. We can feed those extra mouths—we can prevent our passions and our politics blowing our children's world to pieces. The technical and management problems involved are not insoluble. But, they can be resolved on one condition and on one condition only, that we recognize with all its implications the truth of Wendell Willkie's historic phrase that we are indeed 'one world.' That means that disease and undernourishment and disorder anywhere are a cancer in the body politic everywhere. They must be eradicated, not for compassion or idealism, but as the barest common sense of human survival."

Colonel Urwick continued, "That means inevitably government action on a national and international scale. And, pacing Professor Parkinson, I believe that it is possible to make official activity less bureaucratic and more effective. But that means putting management into government, and taking politics out of official action at the executive level."

After commenting on the importance of team work he concluded, "May we, the human team, go forward to defeat the problems which have been created owing to immensely increased control over material circumstances. We have no other choice. But we will need superb teamwork if we are to act in time."

Marshall Anderson, chairman, ASME Management Division, was chairman of the luncheon. The medalist was presented for the award by H. B. Maynard, Fellow ASME, and the presentation of the medal and certificate of award was made by John D. Foster, chairman, Gantt Medal Board of Award.

Gantt Medal Award Luncheon. L. F. Urwick, **second from left,** chairman, Urwick, Orr & Partners, Ltd., London, England, and recipient of Henry Laurence Gantt Gold Medal for 1961, is congratulated by H. B. Maynard, **left,** president, H. B. Maynard & Company, Inc. Looking on are John D. Foster, chairman, Gantt Medal Board of Award, who presented the Medal, and Marshall Anderson, chairman, ASME Management Division. The Gantt Medal is awarded annually by ASME and AMA for "distinguished achievement in management as a service to the community." The luncheon, honoring Mr. Urwick, was held September 15, in New York City, during the annual ASME-AMA Management Conference, September 14–15.



Technical Program

The first, and probably the most popular, paper given at the management conference was "PERT—A New System for Management," by Kenneth M. Tebo. PERT, which stands for Program Evaluation and Review Technique, is a method of completely documenting plans needed

to accomplish a task. This is done in the form of a chart or network made up of points that indicate events and lines that indicate activities. By careful analysis of activities and the events they produce, the network can reveal potential trouble spots, the progress of the project at any time, along with giving a complete picture of the entire working operation. Small operations can use hand calculations on the PERT network, but computers are needed on larger projects.

The second paper of the morning gave a practical example of applying statistics and operations research to a specific problem. Current and potential uses of computers were reviewed in the third paper.

At the first day's luncheon, Nevin Palley spoke on the subject, "The Changing Personality of Today's Engineer." He said, "Many engineers feel inferior in their profession and many are unhappy in their work." To combat this he stated, "It is management's job to provide interesting and creative assignments for the engineer."

The second session covered some of the problems management faces in foreign countries along with a discussion of the engineer's economic environment.

Friday's session led off with the only change in the listed program: Mr. Morehead Wright, of General Electric, replaced the scheduled speaker. In his talk he advocated some rather different ideas in human relations. "Human relations can't be a technique. No group thinking, no teamwork, but integrated individual thinking." . . . It is the job of the manager to integrate the individual thought toward the goal." He was against the many programs and systems that advocated for more effective management. "Don't apply systems to people, treat them as individuals," he said. As to evaluating a man, he thought that indicated or demonstrated capabilities, not personality traits, tell what a man is worth.

The other two papers of the morning dealt further with human relations problems.

The last session Friday afternoon had the topic, Management of Research. Here, two ASME papers were presented. The first, "Managing for Creativity in Engineers," used a research laboratory as a model for explaining the author's theories on stimulating creativity. His over-all rule is, "Listen to, and give real consideration to, the ideas of each person."

The last speaker suggested ways of getting the best performance out of research laboratory personnel. He emphasized that one of the most important jobs of management in a research operation was to make the research personnel feel that they were essential in assisting their company to survive.

Availability List—ASME-AIEE-AIIE Engineering Management Conference

The papers in this list are available in separate copy form until July 1, 1962. Please order only by paper number; otherwise the order will be returned. You can save the postage and handling charges by including your check or money order made payable to ASME with your order and sending both to the ASME Order Department, 345 East 47th Street, New York 17, N. Y. Papers are priced at 50 cents each to members; $1 to nonmembers. Payment also may be made by free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $4 to members; $8 to nonmembers.

61—Mgt-1 Management of Research and Development Personnel in an Industrial Laboratory, by R. B. Mears

61—Mgt-2 Transformation and Value, by F. F. Bradshaw

61—Mgt-3 Increased Profits Through Applications of Computer Technology, by W. W. Eaton

61—Mgt-4 Managing for Creativity in Engineers, by H. C. Vernon

Nominations Open for 1963 ASME Officers

Section Advisers to Regional Advisory Committees on Nominations Provide Channel for Suggestions Requested From Each Member

Although you have just recently had the opportunity to vote for and elect new National and Regional officers who will be responsible for the direction of the Society beginning in 1962, it is already time to start planning for the selection of officers for 1963. This never ending search for the best qualified members available to serve in the administration of ASME is but the exemplification of our principle: The office shall seek the man. Nominations are now open for those offices listed below and by the democratic process of the Society's procedure, you as a member are obliged to initiate such action.

In contrast to our country's national elections, the National Nominating Committee is charged with selecting a single slate of candidates for whom you will have an opportunity to vote next September. In order to choose the best possible candidates, the Committee must have the nomination proposals of the best qualified members who are available to serve—and these nomination proposals must come from you, the regular members of the Society.

Thus it is impossible for the National Nominating Committee to function as it should without your help. You, as individual members in each of our 100 sections, know who the local members are that really make ASME "tick." You can recognize who should be the future Regional and National officers. But the National Nominating Committee may never learn of these outstanding men unless you act in their behalf.

To assist you, a direct line of communication has been established between your individual Section and the National Nominating Committee. Each Section has been asked to appoint a member as an adviser on nominations. Within your Region, the chairman of the Regional Advisory Committee on Nominations will serve as chairman for this group of advisers. He is an individual with Nominating Committee experience. You can obtain the name of the adviser in your Section by asking your Section chairman. The names and addresses of all the members and alternates of the 1962 National Nominating Committee were published in the August, 1961, issue of Mechanical Engineering, pages 118 and 119.

If you know men in your Section who have the acknowledged qualities of outstanding ability and leadership in their profession, please suggest them to your Section adviser on nominations or, better yet, act as a sponsor for such men. Your nomination sponsorship must be on a form, which you can secure from headquarters in New York or from your regional member of the National Nominating Committee.

Those of you who are active in the Professional Divisions as well as those in Section activities should particularly be able to give sound recommendations to your Section adviser on nominations. While the Boards, Committees, and Professional Divisions make recommendations through nominating conferences provided for in the Constitution and By-Laws of the Society, your suggestions to them can also be invaluable. Accordingly, you may make your nomination through your group's representative or directly to H. H. Johnson, Secretary, 1962 National Nominating Committee,

ASME, Consolidated Edison Co. of N. Y., Room 1506-S, 4 Irving Place, New York 3, N. Y.

Offices to be Filled for 1963

President	To serve 1 year
Vice-President Region II	To serve 2 years
Vice-President Region IV	To serve 2 years
Vice-President Region VI	To serve 2 years
Vice-President Region VIII	To serve 2 years
Vice-President Region X	To serve 2 years
Two Directors (at large)	Each to serve 4 years

It is your obligation, privilege, and responsibility as well as that of every other member of the Society to assist the National Nominating Committee in obtaining the best men available for officers of The American Society of Mechanical Engineers.

ASME Elects New Officers by Letter Ballot

For the election of 1962–1963 officers, as reported by the tellers M. F. Dallen, Jr., H. P. Kallen, and Reese W. May, letter ballots received from members of The American Society of Mechanical Engineers were counted on Sept. 26, 1961.

The total number of ballots cast was 12,664; of these 46 were thrown out as defective.

For President	Votes for	Votes against
Clifford H. Shumaker	12,571	47
For Regional Vice-President —serve until June, 1964		
Edward H. Walton	12,567	51
Robert W. Worley	12,567	51
Robert Nelsen	12,573	45
Niles H. Barnard	12,568	50
Emmett E. Day	12,568	50
Thomas J. Judge	12,557	61
For Directors —serve until June, 1966		
Ernst W. Allardt	12,574	44
George M. Muschamp	12,572	46
John Parmakian	12,581	37
For Directors —serve until June, 1964		
Robert C. Allen	12,574	44

The new officers will be introduced and installed during the 1961 ASME Winter Annual Meeting to be held at the Statler Hilton Hotel, New York, N. Y., Nov. 26–30, 1961

Biographical sketches of the newly elected officers were published in the August, 1961, issue of Mechanical Engineering, pp. 113–118.

Temperatures Rising at National Power Conference

A session on nuclear power plants led off the technical presentations at the National Power Conference held March 24 to 30, 1961, in San Francisco.

Reactors. The AIEE, who cosponsored the meeting with the ASME, presented three papers on the topic. Two dealt with experimental reactors; one, the ESADA Vallecitos Experimental Superheat Reactor, the other, a prototype for an advanced sodium-cooled power station. A third paper was a progress report on the status of the high-temperature gas-cooled reactor. The only ASME paper of the morning concerned the Spectral Shift Control Reactor. "The SSCR is a variation of the pressurized water reactor concept wherein reactivity control is accomplished by varying the concentration of a heavy-water light-water mixture."

Boilers and High-Temperature Steam. Eight more papers on the topics of boilers and high-temperature steam were presented at the day's other sessions. Seven of the eight papers were from ASME. Those dealing with high-temperature steam discussed the results of several research projects. One paper was a continuation of ASME research on high-temperature steam generation to determine the high-temperature strength and stability of certain tube materials. This report considered several austenitic steels and nickel-base alloys that had been exposed from 12 to 18 months to steam temperatures of 1200, 1350, and 1500 F. Another report evaluated the weldments of superheater tube alloys. These weldments, of some 17 different alloy types, had been subjected to steam temperatures of 1100 and 1500 F without developing major defects. A discussion of the effect of corrosion on heat transfer in alloy tubes also was presented.

Papers at the fourth session, on operating economics, were all presented by members of the AIEE. Topics here included: Electric-energy transmission versus fuel transportation, auxiliary drives, outage records, and economic scheduling of generation.

Automation. Automation, always a popular topic, was covered first by a general "Philosophy of Boiler Automation." Then, there were more specific examples of automation in the use of parallel programming and solving a problem in heat measurement.

As a followup to the automation program there was a session on instrumentation for plant-performance testing. Several AIEE papers discussed applications of computers to testing as well as the instrumentation for dynamic response testing.

A money-saving idea on a new technique for starting steam turbines led off the last session on turbine generators. This idea reduces the temperature shock to turbine metal during starting and initial loading. The following paper also dealt with a heat problem, that of thermal transients in large generators. Finally, an ASME paper presented the interesting idea of combining a sea-water distillation cycle with a steam-power generation cycle.

Inspection Trips. Aside from the sessions there also were two inspection trips to generating plants in the area. The first group visited the Pittsburg power plant of the Pacific Gas and Electric Company. It is the largest electric-generating plant west of the Mississippi. The Geyser power plant, America's first geothermal plant, also was visited. The unique feature of this operation is that it uses natural steam from the bowels of the earth to generate electric power.

Availability List—National Power Conference

The papers in this list are available in separate copy form until July, 1, 1962. Please order by paper number; otherwise the order will be returned. You can save the postage and handling charges by including your check or money order made payable to ASME with your order and sending both to the ASME Order Department, United Engineering Center, 345 East 47th Street, New York 17, N. Y. Papers are priced at 50 cents each to members; $1 to nonmembers. Payment also may be made by free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $4 to members; $8 to nonmembers.

61—Pwr-1 The Effect of Corrosion by Steam at 1100–1500 F Upon the Heat Transfer Through Superheater Tube Alloys, by H. L. Solberg, J. E. Brock, and W. J. Rebello

61—Pwr-2 Save That Turbine—A Starting Technique Temperature Shocks to Turbine Metal During Starting and Initial Loading Can Be Reduced by This Technique, by J. R. Hamann and D. C. Parker

61—Pwr-3 Scaling Behavior of Superheater Tube Alloys in ASME High-Temperature Steam Research Tests at 1100–1500 F, by F. Eberle and C. H. Anderson

61—Pwr-4 Metallurgical Evaluation of Superheater Tube Alloys After 12 and 18 Months' Exposure to Steam at 1200, 1350, and 1500 F, by C. L. Clark, J. J. B. Rutherford, A. B. Wilder, and M. A. Cordovi

61—Pwr-5 Evaluation of Weldments Joining Superheater Tube Alloys After Exposure to Steam Temperature of 1100–1500 F, by W. E. Clautice

61—Pwr-6 Spectral Shift Control Reactor, by J. Coughlin

ASME Petroleum Engineers . . . inspect TWA Training Center, one of the largest of its kind in aviation industry. Another plant tour took in the Platte Pipe Company remote control headquarters center which controls all stations along the entire pipeline network. The 16th ASME Petroleum Mechanical Engineering Conference was held in Kansas City, Mo., September 25–27.

W. H. Byrne Urges Oil Research Pool at ASME Petroleum Conference

ASME President W. H. Byrne suggested the pooling of research efforts in the petroleum industry for greater effectiveness and economy.

Speaking at the Welcoming Luncheon of the Petroleum Mechanical Engineering Conference, Mr. Byrne said, " . . .by eliminating, at least to some degree, the duplication and secrecy in research we would be multiplying the effectiveness of a valuable resource—time of skilled men."

Mr. Byrne added: "The idea that we are wasting this resource is a frightening one. By co-ordinating operations our national interest can best be served.

"At the same time private enterprise can be made more effective in the field of research. There is an enormous amount of duplication of research effort in the country with five to ten companies carrying out parallel research.

"But in the struggle between the East and West it seems unreasonable to devote enormous amounts of skill and time and money to carry out such duplication."

Mr. Byrne pointed out that co-ordination of research projects does not mean turning this function over to government. "Within the engineering and technical societies is the framework for such co-ordination. There is no reason why jointly sponsored research cannot be extended into the petroleum industry."

"While the arrangements were not adapted to projects involving matters of direct competitive advantage," Mr. Byrne said, "it could prove valuable in the field of basic research."

"It's a common-sense arrangement and it works," Mr. Byrne concluded.

Availability List—Petroleum Mechanical-Engineering Conference

The papers in this list are available in separate copy form until July 1, 1962. Please order by paper number; otherwise the order will be returned. You can save the postage and handling charges by including your check or money order payable to ASME with your order and sending both to the ASME Order Department, 345 East 47th Street, New York 17, N. Y. Papers are priced at 50 cents each to members; $1 to nonmembers. Payment also may be made by free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $4 to members; $8 to nonmembers.

61—Pet-1 Strength of Thick-Walled Pressure Vessels for Materials With Directional Properties, by A. E. Dapprich, J. Marin, and Tu-Lung Weng

61—Pet-2 Strain Hardening in the Yielded Compound Cylinder, by S. J. Becker and H. Draus

61—Pet-3 Working of Metals Via Explosives, by J. S. Rinehart

61—Pet-4 Industrial Utility Cycle Study Adapted to Linear Programming, by T. W. Stubblefield and G. C. McKeague

61—Pet-5 Causes and Prevention of Decay of Wood in Cooling Towers, by R. H. Baechler, J. O. Blew, and Catherine G. Duncan

61—Pet-6 Automation in Orifice Fittings, by H. H. Hodgeman and T. J. Filban

61—Pet-7 Vessel Nozzles and Piping Flexibility Analyses, by P. G. Stevens, V. J. Groth, and R. B. Bell

61—Pet-8 Chemically Treating Cooling-Tower Lumber Protects Against Fungus Attack, by J. R. Goff and J. S. Excell

61—Pet-9 Explosive Metal Forming Techniques, by V. H. Monteil

61—Pet-10 The Effects of External Pressure on Thin-Shell Pressure-Vessel Heads, by E. O. Jones, Jr.

61—Pet-11 Mechanical Refrigeration in Field Processing, by J. L. Horton

61—Pet-12 Factors in Automating Engineering Graphics, by D. W. McArthur

61—Pet-13 Automatic Control With the Plug Valve, by J. A. Pommersheim

61—Pet-14 Programming a Liquid Pipeline Operation for Optimum Power Conservation, by P. Pancio, Jr.

61—Pet-15 Rubber—An Engineering Material for the Petroleum Industry, by D. R. Hall

61—Pet-16 Study of Gas-Engine Performance Leads to Oil Development, by E. W. Brennan and R. H. Moth

61—Pet-17 Automatic Station Control for Reciprocating Compressors, by A. C. Winter

61—Pet-18 Selecting and Specifying Rubber for Petroleum Industry Use, by R. C. Bascom

61—Pet-19 Welding Processes for the Longitudinal Seam of Line Pipe, by R. S. Ryan and P. J. Rieppel

61—Pet-20 Deformation of Drill Pipe Held in Rotary Slips, by T. Vreeland, Jr.

61—Pet-21 Least Cost Estimating and Scheduling, by F. Backer, Jr., A. W. Barkson, and M. C. Frishberg

61—Pet-22 Epoxy Resin as a Tool in Plant Maintenance, by R. H. Bacon

61—Pet-23 Investigation of Sucker-Rod Pumping Performance, W. E. Snyder

61—Pet-24 Mechanisms of Failure of Plastic Pipes in Plant Usage, by L. W. Gleekman

61—Pet-25 Numerical Machine Control, by V. E. Rogers

61—Pet-26 Application of Optical Equipment for Installing and Checking Large Machinery, by J. Hanold

61—Pet-27 Factors Involved in Supplying Electric Service to Pipeline Pump Stations, by T. V. Grayson

61—Pet-28 Modern Centralized Dispatching of the Mid-America LPG System, by W. F. Haley and G. V. Rohleder

61—Pet-29 Use of Positive Displacement Meters to Develop Tank Tables, by R. H. Pfrehm

61—Pet-30 Application of Energy Principles for Finding Critical Hook Loads in Drill Pipe, by D. W. Dareing

61—Pet-31 Planning and Forecasting Steam-Electric Requirements for a Large Refinery, by W. B. Thomas and C. H. Griffenberg, Jr.

61—Pet-32 Design of Engine Jacket Water-Cooling Systems That Use Circulating Pumps, by D. E. Marquis

61—Pet-33 Development of 5500-Bhp Compressor Engine With En Bloc Compressor Cylinders, by F. M. McNall and J. J. Murphy

61—Pet-34 The Special Equipment and Problems Associated With Large Diameter Rotary Drilling, by J. H. Allen

61—Pet-35 Clearly Defined Ideals, by T. B. Foster

61—Pet-36 Columbium-Treated Pipeline Steels, by C. L. Altenburger

1

1 Registration. Left to right, R. Benninghoven, chairman, Section-Division Conference Arrangements Committee, and F. K. Zerbe, secretary, Petroleum Division Executive Committee, check as Ed Lindsay of A. O. Smith Corporation, Houston, Texas, registers in for technical sessions, plant tours, and social events. In all more than 400 attended.

Big Story.
When H. Roe Bartle, Mayor of Kansas City, Mo., welcomed ASME Petroleum Conference, it carried considerable weight. ASME President Byrne, slightly lighter, but more serious, urged oil research pooling as a saving in money, manpower, and duplication.

Kansas City Welcomes ASME

2 Technical Sessions. One of the 20 technical sessions at which the discussions covered present status and future plans for manufacturers, and fields of refining, gas products, and petrochemicals; drilling and production; transportation; and materials as well as panels on plant maintenance and on ASME Unfired Pressure Vessel Code and ASA B31.3 Code for Refinery Piping. Some 40 papers were presented.

3 Leaders in Petroleum. Left to right, G. W. Lunsford, vice-chairman of the Petroleum Division Executive Committee; A. F. Rhodes, chairman; J. P. Mooney, chairman, Advisory Committee; and E. W. Jacobson, whose contributions added greatly to "revive and revitalize" the Division.

4 Congratulations. E. C. Newton, **left,** receives congratulations and certificate from A. F. Rhodes for his outstanding work for the Division.

5 A Good Job. Mr. Rhodes, **left,** thanks R. Benninghoven for his splendid co-operation in planning and scheduling of technical sessions, luncheons and banquets, and industrial inspection trips.

6 Retiring Chairman. J. P. Mooney, **left,** as immediate past-chairman of the Petroleum Division and present chairman of the Advisory Committee, receives a certificate and congratulations from Mr. Rhodes, chairman of the Petroleum Division.

7 A Good Word. Chester Lauck of Continental Oil Company, Houston, Texas, gives banquet talk. His address—full of homey truths—pointed out that ". . . an economist is a guy who talks about money like them that's got it." He also emphasized this point: "When they say we're second to the Russians, don't believe it." He may be right on the first; it's up to all of us to make certain he's right on the second. Mr. Lauck is Lum of Lum and Abner fame.

2

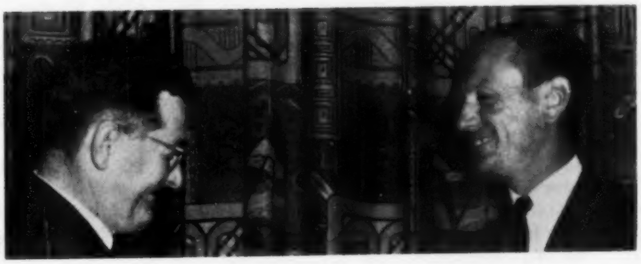
3

Petroleum Conference

4

5

7



6

Conducted for the National Junior Committee

STEWART H. ROSS[1]

JUNIOR FORUM

The Manufacturing Engineer

By Dewey M. Griffith[2]

SIMPLY STATED, manufacturing engineering is engineering applied to manufacturing operations. It is a relatively new area within the manufacturing organization, and it is also an exciting new field for mechanical engineers.

Young graduate engineers usually have three major areas to choose from when they make the transition from college to industry: Engineering, manufacturing, or sales. A great deal is known about what qualities are required for success in engineering and sales, but what about manufacturing?

Qualifications. The primary qualification for engineers in manufacturing is that of a versatile personality. Manufacturing engineers must be able to cope with people of varied backgrounds, to understand, talk with, and live with people ranging from the least educated to those with master's and doctor's degrees. This often requires a conscious personal adjustment for each encounter during the course of the working day.

In the engineering or sales fields, the engineer associates with people of about the same educational level; there are few conflicts in the communication of ideas or social status levels.

In manufacturing, however, the work brings one into contact with people from the manager of manufacturing to the semiskilled man in the shop. The manufacturing manager must see your professional side; the shop worker must regard you as his friend and adviser.

The manufacturing engineer, then, must be able to foresee the value of each individual's contribution to the progress desired, and be firm in his demands in a way that will promote a willingness in others to co-operate.

A secondary qualification required of manufacturing engineers is that of motivation. The desire must be created to eliminate a problem through untiring methods of attack. The person who gives up in the face of frustration will never know if he would have been successful or not. To follow through on a plan of attack—to get the job done—takes courage, initiative, and plenty of creativity. But as Pareto said, "Give me a fruitful error any time, full of seeds, bursting with its own corrections. You can keep your sterile truth for yourself." How well this can apply to the manufacturing field!

Manufacturing Engineers in Foreground. Manufacturing engineers today are in the foreground. Foreign competition has forced American industry to turn increasingly to automation for its manufacturing processes. As a result, costs no longer can be reduced without the manufacturing engineer constantly devising new machines and new uses for the modern methods of production.

The manufacturing engineer is industry's answer to the need for creative thinking in manufacturing. Through his efforts, much efficiency and cost reduction has been and will be realized. His success has been attained not only through his technical ability, but also through his versatile personality and constant motivation.

[1] Proposals writer, Product Information Operation, General Electric Company, Pittsfield, Mass. Assoc. Mem. ASME.

[2] Manufacturing engineer, Westinghouse Electric Corporation, Richmond, Ky. Assoc. Mem. ASME.

The Junior Session: 1961 ASME Winter Annual Meeting

Each year the National Junior Committee sponsors a program at the Winter Annual Meeting. The program's theme is always one of assistance—assistance to young engineers in their professional endeavors. Some portion of the engineer's career environment is selected for study by experts and they are invited to prepare addresses. An effort is made to find speakers whose experience qualifies them to speak with authority, but whose youth keeps their comments directed to the particular problems of a young professional.

The entire program is called the Junior Session, and it's aimed right at you. The 1961 Junior Session is scheduled for November 28 at 8:00 p.m.; the room number will be published in the Winter Annual Meeting program.

This year, the Junior Session Chairman, Bernard A. Meany from IBM, picked "Patents and Professional Development" as the area to be explored. Since graduating from Marquette University five years ago, Mr. Meany has been a patent engineer—and has found that many young engineers have little knowledge of the mechanics of the U. S. patent system nor are aware of the importance of patents to individuals and companies. Further, few young engineers know how to use efficiently an engineering library, much less the information contained in issued patents.

Three recognized authorities in the field of patents and technical libraries will speak at this year's Junior Session and answer questions from the audience.

The first speaker will be John F. Hanifin, domestic patent operations manager of the IBM Corporation, who will speak on "The United States Patent System." Mr. Hanifin will discuss how the U. S. patent system evolved, what constitutes a patentable invention, and how a patent is processed and granted. Mr. Hanifin has responsibility for the direction and implementation of IBM's patent policies in the United States, possesses degrees in engineering and law, and has served as an Examiner in the U. S. Patent Office.

L. E. Marn, the Manager of the Patent and Licensing Department of the Lummus Company, will then speak on "The Value of Patents." Mr. Marn will show, by example, how both the inventor and his employer can profit from patents. He will also mention some technical areas that now offer the possibility of broad patent coverage. Mr. Marn also holds degrees in engineering and law and directs the patent activities of a well-known engineering firm.

The last talk, "Some Prior Art Sources—Engineering Libraries and the U. S. Patent Office," will be presented by H. S. White. Mr. White is manager of the Engineering Library at the Command Control Center of the Federal Systems Division of the IBM Corporation. He is also chairman of the Science-Technology Division of the Special Libraries Association. His lecture will describe the services offered by your library as well as a description of the world's largest engineering library—the Engineering Societies Library housed in the United Engineering Center.

All of these men have expressed a genuine desire to share their knowledge with young engineers. Each one has

evidenced a strong interest in participating in this year's Junior Session—a program unique to technical society presentations. Their aim is to help make engineering careers more rewarding as a result of professional participation in the U. S. Patent System.

Plan now to spend a profitable evening at the 1961 Junior Session with a group of your peers.

Further, for those who will be attending the November 28 daytime sessions of the Annual Meeting, NJC Chairman Norman J. Viehmann cordially invites all young Associate Members to the 2:30 p.m. business meeting of the National Junior Committee. Young ASME Associates interested in serving on the National Junior Committee should plan to sit in on this afternoon meeting.

ASME CODES AND STANDARDS WORKSHOP

Interpretations of 1955 Code for Pressure Piping

From time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinions of the Committee.

Pending revision of the Code for Pressure Piping, ASA B31.1—1955, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions. Cases N-11 (Reopened) and N-12 are published herewith as an interim action of Sectional Committee B31 on the Code for Pressure Piping that will not constitute a part of the Code until formal action has been taken by the ASME and by the American Standards Association on a revision of the Code.

N-11 (Reopened) Requirements on Expansion Joints

Inquiry: What means may be used to provide thermal expansion in nuclear piping systems?

Reply: It is the opinion of the committee that any sound means of providing for thermal expansion may be used. It is recommended that these means be provided by plain or corrugated pipe bends, offsets, changes in direction of the pipeline itself, or bellows expansion joints. What ever means are used must meet the following requirements:

1 Provision for expansion must meet the requirements of ASA B31.1-1955, Section 6, Chapter 3.

2 Be of materials recognized by ASA B31.1 and Code cases prefixed by N as satisfactory for the specified conditions.

3 If of a sliding or swivel-type, have a positive seal or a leakoff which reasonably assures that the leakoff will be contained within the main or auxiliary nuclear piping systems.

4 The designer is cautioned to provide for unusual thermal expansion due to rapid temperature fluctuations, especially in liquid-metal piping systems.

N-12 Procedures for Qualifying New Materials for Use in Nuclear Piping Systems Covered by the Code for Pressure Piping ASA B31.1

Inquiry: What is the procedure for qualifying new material for use in nuclear piping systems?

Reply: The qualification procedure for materials whether new or commercially available in nuclear piping systems has been established as one of the standards by the Committee on Nuclear Piping of ASA B 31. The procedure is believed to be a uniform method of handling inquiries and working stress determinations. The procedure which follows incorporates criteria that are presently accepted for high-pressure steam piping as well as nuclear requirements that appear to be pertinent for material acceptance.

1 *ASTM Identification.* It is desirable that the material be identified with an ASTM Standard Specification or an ASTM Tentative Specification. If the material varies only slightly from an ASTM Specification by the addition, for example, of a small amount of alloying element, it should be stated that the material will comply with that Specification except as noted. The exception should be stated as to chemical composition and to mechanical properties based on test results and tensile data.

2 *Alternate Indentification.* If no ASTM Specification can be applied, the following information shall be given in the same form as used by the ASTM giving ranges of values within which it is commercially practical to reproduce the material rather than an exact determination of the properties.

(*a*) Chemical composition showing all significant alloying elements including for ferrous material, carbon, manganese, phosphorus, sulfur and silicon, together with alloying elements, if any. The maximum content of the following residual elements shall also be furnished: cobalt, tantalum, and boron.

(*b*) Ultimate tensile and yield properties, over the temperature range of contemplated service. Where the materials are to be stress-relieved or heat-treated, the tensile tests shall be made after the specimens are similarly treated.

3 *Creep and Stress Rupture Data.*

(*a*) Creep strength over any temperature range of contemplated service within which creep will lower the working strength of the material.

(*b*) The stress-rupture strength over any temperature range within which the material might fail by rupturing.

(*c*) Basis for establishing stress values may be found in Paragraph A-150 ASME Boiler and Pressure Vessel Code Section I (1959).

4 *Physical Properties.*

(*a*) In the case of materials of which no previous use in any form or similar analysis has been had in nuclear service, the specific heat, the coefficient of thermal conductivity and the coefficient of thermal expansion shall be furnished when the material is intended for use in nuclear services where it may be subjected to severe thermal shocks.

5 *Heat-Treatment.* Any heat-treatment required to produce the specified tensile properties shall be described.

6 *Hardness Measurements.* The Brinell or Rockwell hardness of the material, in the state which it will be used, shall be given unless this information is well known.

7 *Impact Strength and Transition Temperature.* If the material is to be used at low temperatures, below −20 F, the impact strength at the lowest temperature to which it will be subjected, or at some lower temperature, shall be given. The impact strength shall be determined in accordance with the requirements of Par. UG-84 of Section VIII of the ASME Boiler and Unfired Pressure Vessel Code, or "V" notch data. It also is suggested that the material transition temperature for per cent ductile fracture, energy absorbed, and lateral expansion plotted against temperature, and any other pertinent data be furnished using impact testing methods outlined in UG-84 specified above.

8 *Radiation and Temperature Effects.* It is important to state whether the new

material is subject to critical changes in physical and mechanical characteristics caused by irradiation or by temperatures within the range of use or fabrication. By this is meant a marked change in brittleness, hardness, ductility, impact strength, grain size, etc.

9 *Microstructure Variations*. It should also be stated whether the material is subject to age-hardening or critical structural changes by a combination of physical and temperature conditions, such, for example, as the age-hardening of certain aluminum alloys after cold-working and subsequent heat-treatment. This is particularly important for conditions which may occur during fabrication that result in such critical changes.

10 *Availability*. It should be stated whether the material is commercially available and can be purchased within the specified range of chemical composition and mechanical properties. If the material is covered by patents so that it cannot be manufactured by anyone who wishes to use it without securing a license or paying royalties, it should be so stated.

11 *Weldability*.

(*a*) If the material is to be welded, it should be stated whether any special procedure is required for arc or gas welding and the amount of experience available for determining the weldability. It should also be stated whether the material is subject to airhardening during welding. If a special procedure must be followed in welding the material, or if the weldment must be preheated, stress-relieved or heat-treated after welding, the procedure should be specified, including the proper temperatures.

(*b*) It is recommended that the tests described in Section IX of the ASME Boiler and Unfired Pressure Vessel Code or their equivalent be made, unless equivalent information is available.

12 *Test Results*. Tests, results of which are submitted to the Piping Code Committee, should be made on representative thicknesses of materials contemplated, in accordance with ASTM testing methods.

ACTIONS ASME EXECUTIVE COMMITTEE

A MEETING of the Executive Committee of the Council was held in the Council Room of the Society on Friday, Sept. 8, 1961. The meeting was called to order by Vice-President Muller who presided in the absence of the President who attended a funeral in the morning.

There were present: D. E. Marlowe, H. N. Muller, L. N. Rowley, and R. B. Smith of the Executive Committee; G. B. Warren, Past-President; E. J. Kates, Treasurer; E. J. Schwanhausser, Finance Committee Chairman; W. F. Thompson, ASME Representative to UET; R. M. Watson and Henry Black, National Committee of Mechanical-Engineering Department Heads; C. E. Davies, Secretary-Emeritus; O. B. Schier, II, Secretary; W. E. Letroadec and W. E. Reaser, Assistant Secretaries; J. J. Jaklitsch, Jr., Editor; H. I. Nagorsky, Controller; J. T. Reid, Research Manager; and A. B. Conlin, Meetings and Divisions Manager.

ASME Staff Members. ***Recognition of Long Service by Staff.*** The Council extended a vote of appreciation in recognition of loyal service to Ricky Hoffman who has served on the staff for 35 years and to Ida Becker who has served (the Chicago area) on the staff for 25 years, and presented each with a honorarium for her fine work.

Finances. ***Financial Statements, May 31, June 30, and July 31, 1961.*** Members of the Executive Committee of the Council expressed concern over the decline in advertising income over the past four years. Display and classified advertising in MECHANICAL ENGINEERING has been reduced from $816,700 in 1957-1958 to an estimated $535,000 in 1960-1961 or a reduction of 34.4 per cent. Advertising in the *Mechanical Catalog* has dropped from $113,400 in 1957 to 1958 to an estimated $90,000 in 1960-1961 or a reduction of 20 per cent. While it is recognized that general business conditions have influenced advertising, it was the consensus of the meeting that this decrease was greater than that experienced by other societies and technical publications. The Secretary, therefore, was requested to submit a report at the October 6 meeting of the Executive Committee on the comparative performances of ASME with the Founder Societies and with technical journals in the mechanical-engineering field. The Executive Committee of the Council approved the financial statements for May 31, June 30, and July 31.

Unexpended Appropriations for 1960–1961. Action on unexpended appropriations is necessary annually; therefore, the Executive Committee of the Council authorized the controller to carry forward to the account "Accrued Liabilities" such unexpended balances for 1960–1961 appropriations for which commitments have been made as of Sept. 30, 1961; also to write back to "Surplus" as of Sept. 30, 1961, such unexpended balances now in "Accrued Liabilities" for which all expenditures for commitments have been made.

Membership. ***Registration as a Professional Engineer.*** On recommendation of the Intersociety Relations Committee, the Executive Committee of the Council voted: To request the Constitution and By-Laws Committee (*a*) to prepare appropriate wording of an amendment to Article C4, Sec. 4 (new C3, Sec. 5) to provide that registration as a Professional Engineer in one or more of the States or territories of the United States or equivalent status in foreign countries be an addition to present requirements for admission to the full Member grade; (*b*) to provide that two years after the adoption of said amendment, all Members in good standing at that time shall continue their membership in that status, even though they may not be registered; and (*c*) to submit the proposed wording of the amendment to the Board on Membership for its consideration and report to the Executive Committee of the Council at its Nov. 3, 1961, meeting.

Council Policies. ***Dues From Members in Foreign Countries.*** The Executive Committee of the Council approved Council Policy P-2.6, "Dues From Members in Foreign Countries," as revised Feb. 6, 1959.

ASME Patent Statement. The Executive Committee of the Council referred the ASME Patent Statement to the Research Executive Committee for review before it is added to Council Policy P-6.14 and correlate it with the Society's research purposes and intents.

Certificates of Award. The Executive Committee of the Council added the following note under 3b of existing Council Policy P-6.2, "Certificates of Award"; "Certificates will not be awarded to members for contributions made while serving on the staff."

Board on Technology. ***Registration Fees for General Society Meetings.*** The 1961 Regional Delegates Conferences approved the proposal that members attending

General Society Meetings be charged a nominal registration fee not to exceed $5 and that nonmembers be charged twice the member fee. Following the report of the RDC to the Council both the Meetings Committee and the Board on Technology compared fees charged by other Founder Societies which were:

	Member	Non-member	Exemptions	Student Member	Student Non-member
ASCE	$5	$5	None	No charge	No charge
AIChE	6	18	Nonmember authors		
AIEE	6	10	Nonmember authors	No charge	No charge
AIME	10	20	None	No charge	$2

The question was given to the members of the Meetings Committee and the Board on Technology for letter ballot approval. Both letter ballots were favorable. As regards to nonmember registration fee, discussion developed the fact that since 1954 nonmembers have paid a registration fee which was $10 greater than that paid by members. Therefore when members begin to pay a $5 registration fee the same $10 differential will make the nonmember fee $15. The Executive Committee of the Council authorized the charging of registration fees for the 1961 Winter Annual Meeting as follows:

Member	$ 5
Nonmember	15
Nonmember Student	1

with the following exceptions: Authors, ladies, student members, immediate family of a member, and guests invited by the President or Secretary.

Also members of ARS, EIC, I.MechE., societies with membership in EJC or ECPD and any other societies listed as cosponsors in the program are admitted at the member rate. The following nonmembers will be admitted at the member rate: Session chairmen and vice-chairmen and invited discussers. (No fee to attend social events.)

Board on Education. *Mechanical-Engineering Problem Contest.* The Executive Committee of the Council authorized the establishment of the Design Problem Contest under the supervision of the ASME Board on Education and the National ME Department Heads Committee on a pilot operation basis for the academic year 1961–1962; and appropriated $875 from the interest accrued from the Springer Fund for prizes.

Board on Honors. *1961 ASME Student Awards.* The Board on Honors voted by letter-ballot to grant the following Student Awards:

Charles T. Main Award to Lester W. Wurm, Kansas State University, June, 1961, of Escondito, Calif., for his paper, "The Potentialities of Honor Societies and Their Effect on Engineering Education."

Undergraduate Student Award to Joseph J. Marino, The University of Connecticut, June, 1961, of Stamford, Conn., for his paper, "Considerations for the Design of an Ammonia-Phospheric Acid Reactor."

Old Guard Prize. *1961 Recipient.* The Old Guard Committee reports that the 1961 recipient of the Old Guard Prize is Joseph J. Marino of The University of Connecticut, Storrs, Conn.

Research Executive Committee. *Transfer of Funds.* The Executive Committee of the Council voted: (*a*) To disband the Research Committee on Metal Processing and transfer the $1253.89 in the custodian fund to the General Research Fund; and (*b*) to disband the Research Committee on Mechanical Springs and transfer the $182.89 in the custodian fund to the General Research Fund.

Supplements to Research Agreements. In accordance with the Delegation of Authority and approval of the Research Executive Committee, the Secretary signed the following supplements to Research Agreements:

(*a*) Supplement 3 to Research Agreement 84-3 with Brown University increasing the maximum to be paid from $88,050 to $92,163.11 and extending the expiration date from Sept. 7, 1960, to Sept. 7, 1961.

(*b*) Supplement 1 to Research Agreement 37-1 with the University of Michigan changing the method of computing charges as found in Par. 8(*c*) which now reads ". . . *plus 15 per cent of all costs* on account of overhead allocable to the Research Agency's expenditures . . ."

(*c*) Supplement 4 to Research Agreement 7DP-11 and 13 with Battelle Memorial Institute increasing the cost from $5000 to $6500.

(*d*) Supplement 2 to Research Agreement 7DP-14 with Battelle Memorial Institute extending the expiration date from Aug. 31, 1961, to Feb. 28, 1962, and increasing the amount to be paid from $3500 to $7000.

1961 Regular Nominating Committee. *Travel Expenses.* The Executive Committee of the Council voted to deny the request for travel funds for the 1962 Nominating Committee to meet at the Winter Annual Meeting, as funds are not available.

ASME Organization Study. *Final Payment.* The Executive Committee of the Council authorized the Secretary to charge to the "A" Development Fund the sum of $996.65 paid to Cresap, McCormick and Paget for work in excess of the $24,000 set aside from the Society's Development Fund Reserve.

Sections. *Affiliation With Local Engineering Groups.* In view of the Society's legal counsel's opinion, the Executive Committee of the Council voted: (*a*) To withhold further action at this time; (*b*) to refer the latest opinion of our legal counsel to the Sections; and (*c*) to inform the Sections that ASME, AIEE, and NSPE, through their Intersociety Relations Committees, are cooperatively seeking a solution to this problem.

Section Allotments. The Executive Committee of the Council voted to recommend to the National MDC and Local Section Membership Committees the responsibility for urging members in the individual Sections to pay their Society dues by September 30 so that the Section will receive full financial support from Headquarters.

1961 Winter Annual Meeting. *Mileage for Chairmen of Boards and Committees.* The Executive Committee of the Council authorized travel allotments to the Council meetings in New York, N. Y., on Nov. 26–27, 1961, to those Chairmen of Boards and Committees having a seat on the Council who advise in writing that they have business to present and who request such allotment in accordance with the provision in Council Policy P-4.5.

Legacy. *Lewis F. Lyne, Jr.* The Executive Committee of the Council accepted with appreciation the bequest of $1000 from Lewis F. Lyne, Jr., in memory of his father, one of the founders of ASME; and added the gift as the Lewis F. Lyne, Sr., Fund to the Awards Funds of the Society.

Robert Fulton. *Robert Fulton Memorial.* The Executive Committee of the Council authorized the Secretary to have the bronze plaque on the Robert Fulton Memorial in Trinity Churchyard depicting the design of the Claremont reinscribed for the sum of $448 to be charged to the "A" Development Fund.

Robert Fulton Table. The Executive Committee of the Council voted to offer the Robert Fulton Table to an historical museum on a permanent loan basis.

Power and Mechanical Engineering Exposition. *Discontinuance of ASME Support.* The Executive Committee of the Council confirmed action taken by President Byrne in his letter of Aug. 14, 1961, to E. K. Stevens, President of International Exhibition Company, Inc., which,

among other suggestions, recommended that ASME withdraw as the sponsor of the Power Show.

Engineers' Council for Professional Development. ***Annual Report.*** On recommendation of the ASME Representatives to ECPD, the Executive Committee of the Council approved the formal report of the ASME Representatives on the ECPD for presentation to the Annual Meeting of ECPD to be held on Oct. 2–3, 1961, in Louisville, Ky.

Merit Badge Pamphlet on Mechanical Engineering. The Executive Committee of the Council referred the proposal to prepare a merit badge pamphlet on engineering for the use of the Boy Scouts of America to ECPD and Junior Engineering Technical Society (Jets).

U. S. National Committee on Theoretical and Applied Mechanics. ***Dues to IUTAM for 1961.*** The Executive Committee of the Council authorized the payment of $210 from C-14 account as the Society's dues payment for 1961 to the International Union on Theoretical and Applied Mechanics.

Admission of Two Societies to U. S. National Committee. The Executive Committee of the Council approved the admission of the American Society for Testing and Materials and the Society of Rheology as members of the U. S. National Committee on Theoretical and Applied Mechanics.

United Engineering Center. ***Resolution of Appreciation.*** The Executive Committee of the Council sent a resolution, on behalf of the members and the staff of the Society, expressing appreciation to the United Engineering Trustees, to the Real Estate Committee, and to the architects, engineers, and constructors for the magnificent symbol of the engineering profession which they have created.

Joint Awards. ***1961 Recipients of Awards in Which the Society Participates Are as Follows:***

Wallace Clark Award, Joseph J. Cussen, Santiago, Chile;

John Fritz Medal, Crawford H. Greenewalt, Wilmington, Del.;

Gantt Gold Medal, Lyndall F. Urwick, London, England;

Daniel Guggenheim Medal, Jerome F. Lederer, New York, N. Y.;

Herbert Hoover Medal, Mervin B. Kelly, New York, N. Y.;

Alfred Noble Prize, G. S. Reichenbach, Cambridge, Mass.;

Elmer A. Sperry Award, R. G. LeTourneau, Longview, Texas, and to the Research and Development Division of

INSIDE ASME

Classic Car

ASME Secretary O. B. Schier, II, still owns—and occasionally drives—a straight-eight Buick which cost $1100 . . . in 1936. No need to remind you what a comparable Buick would cost today. We probably have 10,000 young members who have no recollection—or only dim recollection—of those prewar days.

Point of all this: In 1936, membership in ASME ranged from $10 for young new members, to $20 for full membership. Today it is $10 to $25.

Howl from the balcony: But many of your services are higher. Publications, meetings fees; they're up.

Yes, they are. ASME is a nonprofit organization, providing a host of services to the profession: Codes and standards, research, publication of a tremendous amount of technical literature. Much of this we are duty bound to produce even though it shows a "loss." We hold costs down, and search for the most equitable means of having the membership meet these costs.

ASME has no consumers to whom it can pass its rising costs. Our members do have, directly or indirectly. Through them, we are involved with the creation of new and better products for the satisfaction of tens of millions of consumers, users of engineered products. We'd like to collect ten cents—just for one day—from all the people who ride in elevators, and who do so in safety and ease-of-mind because of the ASME Elevator Code.

Anniversary

And then, there's the Boiler Code. We've just passed the Fiftieth Anniversary of that ASME Code which may be the most important single project the Society has ever undertaken—for industry, and for the public. On Sept. 15, 1911, the Council took action to set up what later became the Boiler Code Committee.

Those were the days when boiler explosions were happening with tragic frequency. There was a crying need for a legal code for boiler design and construction. Today . . . we must have young members who've never heard of a boiler explosion. The ASME Boiler Code is now the basis of the law in 38 States and four territories (Canal Zone, Guam, Puerto Rico, and D. C.); also, all provinces of Canada, and many cities of the U. S. where the state laws do not incorporate the Code.

Smog

Did you know that ASME has an Air Pollution Controls Committee? (One of those Committees that could someday become a Division.) This Committee will join with the Human Factors Group in presenting a panel session (Safety 1) at the Winter Annual Meeting, Monday morning, November 27, on "The Mechanical Engineer and the Industrial Hygienist." Maybe you ought to be there.

"Smog News," one of the special publications put out by ASME, is a 20-page booklet issued twice a month containing items gathered from all over the country on the battle against smog. If you want to be informed, you can subscribe: The cost—$10 a year. It's a thorough compilation of the legal, political, and engineering developments in this field. To subscribe, write to ASME Order Department, United Engineering Center, 345 East 47 Street, New York 17, N. Y.

Compact Winter Meeting

This year's Winter Annual Meeting will be streamlined in one important respect: Fewer sessions, scheduled into four days instead of five. Technical sessions will start Monday morning, November 27, and continue through Thursday the 30th.

Engineers who have presented papers on the last day of a long meeting can tell you, sadly, of the falloff in attendance on that last day. By

Firestone Tire and Rubber Company;

Washington Award, William V. Kahler, Chicago, Ill.; and

Marston Award, Wilmot A. Danielson, Memphis, Tenn.

American Society of Civil Engineers. *Freeman Fellowship.* The Freeman Fellowship for the academic year, 1961–1962, has been awarded to Prof. J. W. Delleur, Assoc. Mem. ASME, Purdue University. A sum of $3000 has been allocated for his use at the University of Grenoble, France. The Award was administered this year by ASCE.

Niels Bohr International Gold Medal. *1961 Recipient.* The Institution of Danish Civil Engineers has announced the 1961 Niels Bohr International Gold Medal will be presented to Dr. George de Hevesy on Oct. 4, 1961.

Chinese Institute of Engineers. *50th Anniversary.* The Chinese Institute of Engineers will celebrate its Golden Jubilee on Nov. 13, 1961. A congratulatory letter will be sent.

American Society of Safety Engineers. *50th Anniversary.* ASSE will celebrate its Golden Jubilee on Oct. 8, 1961. A congratulatory greeting will be prepared.

Certificates of Award. *Management Division.* The Executive Committee of the Council authorized the preparation of certificates of award for Harold B. Maynard and J. Keith Louden for organizing the first Management Executives' Conference in 1945 and for their continued support of succeeding Conferences.

Board on Codes and Standards. On recommendation of the Board on Codes and Standards a certificate of award has been prepared for Alf Kolflat for his work as chairman of Subcommittee 2 on Containment, under ASA Sectional Committee N6, Reactor Safety Standards from August, 1958, to April, 1961.

Retired Section Chairmen. On recommendation of their respective Vice-Presidents certificates of award have been prepared for the following 1959–1960 Section Chairmen: W. H. Wallace, Arizona; A. G. Walton, Jr., ArkLaTex; W. C. Bissmeyer, Cincinnati; R. J. Sullivan, Milwaukee; B. T. Thompson, Jr., North Alabama-Mississippi; and J. P. Wilson, North Texas.

Retiring Section Chairmen. On recommendation of their respective Vice-Presidents, certificates of award have been prepared for the following retiring 1960–1961 Section Chairmen: J. H. Palmer, Baltimore; I. P. Hooper, Central Indiana; Daniel Schild, Dayton; L. J. Brancato, Fairfield County; A. F. Green, Hartford; R. F. Walden, Hawaii; M. E. Jansen, Nebraska; M. B. Crotts, Piedmont-Carolina; Thomas Howitt, Jr., Southern Tier; and W. H. Weber, St. Louis.

Appointments. *Director of the Society.* The Council voted by letter ballot to appoint R. C. Allen to serve the unexpired term of Director until the new officers take office in June, 1962, and in this capacity to serve on the Finance Committee.

Presidential. (*a*) Tellers of Election: M. F. Dallen, Jr., H. P. Kallen, and R. W. May.

(*b*) Morrough P. O'Brien—presentation of James Watt Award to Dr. Theodore von Karman, Sept. 13, 1961, The Institution of Mechanical Engineers, London, England.

(*c*) Representatives on the Operating Committee of the United Engineering Center: W. E. Letroadec and O. B. Schier, II.

Board on Membership. *Report.* After luncheon the Executive Committee of the Council convened with members of the Board on Membership.

There were present: W. H. Bryne, President; D. E. Marlowe, H. N. Muller, and L. N. Rowley, Jr., members of the Executive Committee; G. B. Warren, Past-President; W. E. Belcher, J. A. Brown, A. M. Perrin, W. A. Vopat, and H. H. Wormser of the Board on Membership; O. B. Schier, II, Secretary; and W. E. Reaser, Assistant Secretary.

L. N. Rowley, as the Director assigned to the Board on Membership, summarized the report on Membership. The Executive Committee of the Council, after discussion with the members of the Board voted: (*a*) To accept the Board on Membership report; (*b*) to refer the report to the Organization Committee; and (*c*) to extend the appreciation of the Executive Committee of the Council to the Board on Membership for their excellent report.

eliminating the fifth day, and scheduling four days of solid technical sessions, we expect to have a more compact, better-attended meeting.

The banquet will be held Wednesday evening, the 29th.

While you're in New York, there's a new item on the list of landmarks being announced over the loudspeaker systems of sight-seeing buses and round-Manhattan boat trips: The new United Engineering Center.

Package Deal

At hand is a folder announcing a meeting of another society: The price to members, $45, to nonmembers, $60. Point of interest: This is a package deal, the price including the dozen or so preprints, plus two luncheons.

Quite aside from whether the price is high or low, the blanket price is an idea into which ASME has so far only dipped its toe. We've generally run our meetings and conferences cafeteria style—select the papers you want, decide on the social functions you want to attend, and pay for just those. For a huge meeting, with overlapping functions, that's the only way.

But in certain of our conferences, we've included the preprints in the fee. And sometimes, where the conference was held on a college campus, meals and even housing were included in the fee. Currently, there's a conference of the Textile Engineering Division (at M.I.T., Cambridge, Mass., November 1-2) in which the member's registration fee of $12 will include the banquet.

Such a package deal can simplify the work of running a conference. Would you like to see a blanket price for the entire operation?

Outstanding Men

At a meeting of the Publications Committee, we had this question thrown at us:

"Who are the current great mechanical engineers?"

It was embarrassing how few we could name, just offhand (and it had to be offhand, to prove the point). One thought, of course, of Kettering—no question of the greatness, there. Most were names not known to the general public. How many could you name?

Too late, it occurred to us to ask, "How many medical doctors are known as great?" Is there something about professional life that buries men?

Where do the "greats" come from? The literary world, management, the labor movement, the sports world, politics. But where are the engineers?—*Maurice Barrangon.*

OBITUARIES

Charles Anderson Alexander (1872-1961), retired, president and treasurer, Alexander Shumway & Utz, Rochester, N. Y., died June 22, 1961. Assoc-Mem. ASME, 1899; Mem. ASME, 1905.

John Lord Bacon (1878-1961), retired consulting engineer, San Diego, Calif., died April 25, 1961. Assoc-Mem. ASME, 1899; Mem. ASME, 1909.

Robert Randall Baillie (1880-1961), retired, leader inspector of engineering materials, USN, Philadelphia, Pa., died March 31, 1961. Assoc-Mem. ASME, 1919; Mem. ASME, 1935.

Louis Ralph Baker (1891-1961), president, The Pilliod Co., Swanton, Ohio, died June 23, 1961. Mem. ASME, 1940. A designer of locomotive-valve gears, he held patents on the uniflow piston valve and auxiliary valve gear.

George Sands Barker (1894-1961), Comdr., USN, resident inspector of naval materials, Bridgeport, Pa.; died May 27, 1961 Assoc-Mem. ASME, 1916; Mem. ASME, 1939. He was owner and president of The Barker Supply Co. and the Barker Pipe Fittings Co., Norristown, Pa., 1923-1942. He authored a report on the Lewis speeded-up aircraft machine gun in 1918 after taking charge of experimental work to improve it. He wrote the book "Steam Power Plant Equipment."

Fred John Bechert (1890-1960), owner, Mitchell & Bechert, New York, N. Y., died February 23, 1960. Jun. ASME, 1914; Assoc-Mem. ASME, 1920; Mem. ASME, 1935.

Joseph Klee Blum (1888-1961), consulting engineer, New York, N. Y., died July 24, 1961. Jun. ASME, 1909; Assoc-Mem. ASME, 1919; Mem. ASME, 1926. A specialist in combustion, crushing, and pulverizing, his inventions were patented in the U. S. A., Canada, England, France, Germany, Japan, and Italy.

Emmett B. Carter (1878-1960?), retired mechanical engineer, Parsons, Brinckerhoff, Quade & Douglas, New York, N. Y., died last year according to a notice received by the Society. Mem. ASME, 1912. He authored several technical articles and was a former president of the Engineer's Club of Philadelphia.

Dio Lewis Holbrook (1866-1961), retired engineer, who was formerly with the Otis Elevator Co., Point Pleasant, N. J., died, March, 1961. Mem. ASME, 1899.

William Arthur Hotzfield (1915-1961), superintendent of motive power, Mechanical Div., Northfield and Southern Railroad, Minneapolis, Minn., died Feb. 21, 1961. Mem. ASME, 1954.

Robert Russell Kaley (1904-1961), service superviser, Engineering and Service Div., Westinghouse Electric Corp., Denver, Colo., died June 13, 1961. Mem. ASME, 1957.

John Joseph Long (1887-1961?), former president of the Harbor Plywood Corp., Hoquiam, Wash.; retired engineer, Fryeburg, Me., died recently according to a notice received by the Society. He also was former president and director, Capitol Plywood Co., Olympia, Wash.; and director, Pacific Forest Industries, Tacoma, Wash. Assoc-Mem. ASME, 1919; Mem. ASME, 1925. He authored "Cases on Corporation Finance."

Jay Dee Ochs (1934-1960), Lieut., U. S. Army, Redstone Arsenal, Ala., died April 23, 1960. Assoc. Mem. ASME, 1957.

Clifford Horatio Shie (1893-1961), retired mechanical engineer, Diamond Alkali Co., Painesville, Ohio, died April 9, 1961. Jun. ASME, 1921; Assoc. Mem. ASME, 1925; Mem. ASME, 1935.

William Douglas Weir, The Rt. Hon. Viscount (1877-1959), managing director, G. and J. Weir, Ltd., Holm Foundry, Cathcart, Glascow, Lanarkshire, Scotland, died July, 1959. Hon. Mem. ASME, 1920. Lord Weir was Director of Munitions in Scotland. Later, in 1917, he became British Director-General of Aircraft Production, and the next year was Secretary of State for Air. He was elevated to the Peerage for his public services, and built a highly efficient organization in the Cathcart works.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

THE application of each of the candidates listed below is to be voted on after Nov. 24, 1961, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and • Promotions

Alabama

Johnson, Conrad H., Mobile
Martin, Gordon B., Florence
Moore, Harlan K., Birmingham
Tatom, Frank B., Auburn
•White, Lonnie B., Jr., Birmingham

Arkansas

Miller, Joe D., Little Rock

California

Beacham, Robert C., Berkeley
Briley, Gary L., Van Nuys
•Hamm, Harold M., Covina
Hill, Ronald D., San Jose
Wojcik, Charles K., Beverly Hills

Connecticut

Alexander, William J., West Haven
Baharian, Roy E., Darien
Ferro, Francis E., East Haddam
•Kennedy, Richard H., Wolcott
Steinhorn, Daniel, Groton
Tucchio, Michael A., New London

Washington, D. C.

Couchman, Donald L.

Florida

•Ruthven, Beeman, Panama City
Stern, Gabriel E., Miami

Georgia

•Haller, Robert F., Atlanta
•Snellgrove, William A., Atlanta
Wagner, Carl E., Atlanta

Illinois

Kumar, Krishan, Chicago
Schmidt, Russel F., Chicago
•Wojtas, Gustave, Jr., Des Plaines

Indiana

Snyder, George E., Indianapolis
Tipton, Donald L., Speedway

Iowa

McManus, Paul H., Davenport

Louisiana

Gaudin, Louis B., New Orleans

Maryland

Bustard, Thomas S., Lutherville-Timonium
Van Cott, Harold P., Bethesda

Massachusetts

•Billings, Charles E., Belmont
Fand, Richard M., Cambridge
McClean, Fred C., Springfield
•Walker, Donald R., Wilmington
•Zimmerli, Kurt, Holyoke

Michigan

•Adams, Peter J., Saginaw
•Balsbaugh, Richard R., Detroit
•Bastian, Bernhard J., Huntington Woods
Housel, Leslie H., Jackson
•Kelly, Olin A., Jackson
McGinnis, Joseph O., Jr., Flint

Minnesota

Cleland, Charles E., Minneapolis
•DeSilva, Carl N., Minneapolis
•Gasink, Lewis T., Mora
Pankow, Paul A. H., Minneapolis
Pehrson, Wallace G., St. Paul
Sethna, Patarasp R., Minneapolis

Missouri

Hicks, Clarence D., Clayton
•Stiller, Milton A., Kirkwood

Nebraska

•Jansen, Merle E., Columbus
Woodard, Parke H., Jr., Omaha

New Hampshire

•Manter, Donald I., Manchester

New Jersey

Karpf, Jacob Z., Newark
•Kulina, Mark R., Hasbrouck Heights
LoPresti, Ernest A., Sparta
Lynch, Francis J., Jersey City

•Promotion to Member or Affiliate.

Monka, Allan G., Montville
Post, George, Jersey City
Pritchard, James J., Belleville
•Stoughton, Lincoln D., Chatham

New Mexico

•Williams, Don, Jr., Albuquerque

New York

Ambrogi, Raymond R., Corning
•Gebhart, Benjamin, Dr., Ithaca
Healy, James P. V., New York
Hefner, William J., Schenectady
•Johnson, Ray C., Endicott
Larson, Victor A., New York
Legier, Edward W., Jr., New York
Lyon, Floyd A., Glen Head
McNulty, Francis G., Bridgeport
Pettit, Robert H., Huntington
Poyer, Thomas H., Utica
Thompson, Philip A., Berlin
Unger, Michael B., Greenlawn
•Woodward, Stephen G., Elmira Heights

North Carolina

Claus, William D., Charlotte

Ohio

Coffin, Clarkson L., Columbus
Nash, Charles D., Jr., Columbus
Overman, Robert J., Tiffin
Pena, Norbert A., Cincinnati
Pickett, Carl M., Cleveland
Sledge, Barnett J., Hamilton

Van Kuren, James T., Wright-Patterson AFB

Pennsylvania

Beretsky, Irwin, Philadelphia
Evers, Walter G., Bradford
Garofalo, Frank, Pitcairn
Goldsten, Joseph, York
Gormley, Owen P., Bethel Park
•Janson, Leroy W., Clarks Summit
Reese, Richard, Greenville
•Rotary, Joseph D., Pittsburgh
Roda, David, Philadelphia
Staffel, Edward J., Bethel Park

Tennessee

Thompson, William H., Chattanooga
Waddey, Frank O., Memphis

Texas

•Barnhart, Bobby J., Austin
Blum, Harold A., Dallas
Burchsted, Kenneth R., Dallas
Deevy, William J., Beaumont
Fischer, Alvin R., Houston
Knox, Teddy M., Pampa
Prasil, Antone G., Dallas
•Tyllick, Dennis C., Bellaire

Utah

Chapman, Harry V., Salt Lake City

Virginia

Price, Howard L., Jr., Norfolk
Thomas, George B., Berryville

Washington

•Call, Rey L., Richland
Mondt, Jack F., Richland

West Virginia

Hartle, Robert L., Charleston

Wisconsin

Fuller, Joseph R., Milwaukee
Quillinan, William E., LaCrosse

Foreign

Besnyo, George F., Montreal, Canada
Dahiya, Jagbir S., Bombay, India
Juhl, Alfred L., Chile, S. A. (Caletones, Rancagua)
Kemp, Robert A., Montreal, Canada
Khan, Mohammad W., Lahore, West Pakistan
Kirby, Gerald F., London, England
Marianeschi, Edmondo G. A., Terni, Italy
Motluk, Eugene, Hamilton, Ont., Canada
Nakra, Bahadur C., Gurgaon (Punjab), India
Popp, Gerhard P., Noranda, Que., Canada
Rotthier, Karel A., Elizabeth, South Australia
Saha, Manoranjan, Calcutta, India
•Sand, Barrett, Toluca, Mexico
Sarwar, Ghulam Major, Lalkurti, Rawalpindi, Cantt, Pakistan
Singhal, Krishna C., Chandigarh, India
•Surowiak, Stanley H., Windsor, Ont., Canada
Thomas, Kenneth F., Trinidad, W. I.

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC [Agency]

These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or nonmembers, and is run on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee. Upon receipt of your application a copy of our placement-fee agreement, which you agree to sign and return immediately, will be mailed to you by our office. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application.

NEW YORK	CHICAGO	SAN FRANCISCO
8 West 40 St.	29 East Madison St.	57 Post St.

Men Available[1]

New York Office

Engineering Administrator, ME, MS, 12 years' experience in R&D field. Co-ordination of diverse company activities toward common goals. Preparation of budgets, task definitions, and program plans. Customer liaison and project direction. $10,000–$13,000. Prefers New York City, Westchester County, Conn. Me-997.

Assistant to Chief Engineer or Assistant Chief Engineer, BSME; 12 years' diversified experience in project, operations, and maintenance engineering in compressor stations, dehydration, and heavy hydrocarbon extraction plants. Annual operating cost estimates and economic feasibility studies. Contractor supervision during construction. Instructional experience. $12,000. Prefers Midwest, South, East. Me-999.

Research Engineer, Dr. ME; experienced with high-speed two-stroke engines producing 1 Bhp/cu. in., instrumentation, dynamometer tests, combustion thermodynamics, dynamics of high-speed mechanisms, digital computer, heavy background physics, and math. $10,200. Prefers East. Me-1.

Marine Engineer, Project Engineer, experience in the design of ships' power plants, thermodynamic calculations, economic analyses, writing reports and machinery specifications, and ship-test and trial engineer. First Assistant license, five years' experience. $10,500. Immaterial. Me-2.

[1] All men listed hold some form of ASME membership.

R&D Engineer, BSE (mechanical), experience in research stress, vibration, and heat-transfer analysis of machines. Dynamic analysis of loads in mechanisms with kinematic motion involved. Advanced analysis of aircraft design, i.e., frames, landing gear, etc. $9000. Prefers Conn. Me-3.

Mechanical Design Engineer—Construction, or Plant Engineering, BS, BSME; three years' experience in design, selection, procurement, and installation of mechanical systems for new and existing buildings; including air-conditioning, heating, refrigeration, ventilation, steam, water, compressed-air, and industrial-gas systems. $8000. Prefers Midwest, Middle Atlantic, South. Me-4.

San Francisco Office

Plant Manager, Basic Industry, ME, 42; 12 years management engaged in design, construction, servicing, and operating heavy industrial equipment and systems in petroleum, paper, power, cement, steel, nonferrous metallurgical, and chemical industries $18,000. Prefers West Coast. Se-1147.

Sales Engineer, Steel, Bus. Adm.; 47; 26 years' sales, promotion, technical assistance, financing in specialty steel, aluminum, mechanical equipment. $12,000. Prefers San Francisco Bay area. Se-1033.

Design Engineer, Pressure Vessels, mechanical; 35; ten years design and fabrication of heat exchangers, fractionating towers reactors, nuclear steam generators, and other pressure vessels. $12,000. Prefers northern Calif. Se-1003.

Sales Engineer, Turbines, Generators, Mechanical; 46; prefers any industry dealing in tangible product or R&D. $10,000. Prefers West. Se-1716.

Designer, Air, Heating, Mechanical; 58; project design air-conditioning public center, aircraft-assembly plants, project engineer involving mechanical process in large industrial plants. $10,000. Prefers San Francisco Bay area. Se-1198.

Supervisor, Metallurgical, MS (ME) (Iran); 46; 20 years design and supervision for industrial and mechanical design, mechanical construction, and industrial plants. $1000 a month. Prefers Calif. Se-1360.

Project Engineer, Process Materials Handling ME (Poland); 44; 20 years' experience, last nine in design of industrial plants, conveyers (bulk and packaging), materials-handling equipment and systems, supervision responsibility. $9600–$12,000. Any location. Se-1655.

Designer, Air Conditioning, Mechanical; 42; nine years design layout, installation, field survey of semiconductor manufactured equipment, air-conditioning steam plants for industrial use, utilities. $900 a month. Any location. Se-1088.

Design, Development Engineer, Manufacturing, Mechanical; 35; nine year's experience in design and engineering manufacturing. In manufacturing of medium to heavy equipment. Machinist prior to entering college. $850–$900 a month. Prefers Pacific Northwest. Se-1467.

Consultant, Management, Metal Machinery, Mechanical; 55; 17 years' all phases of metal-working product development, equipment selection, plant layout, time study, inspection, and quality and production controls. $800 a month. Prefers San Francisco Bay region. Se-1169.

Project Engineer, Contracting Consulting, Mechanical; 38; seven years' U. S. and three years' European experience in petrochemical plant and heavy mechanical-equipment engineering. Comprising layout, design, inspection, specification writing, and purchasing. $750 a month. Prefers San Francisco, Los Angeles, overseas area. Se-1231.

Plant Engineer, Design, Production, Mechanical; 33; one year applications in monorails, bridge cranes, hoists, power and gravity conveyers, electric trucks, and other material-handling equipment. Three years' design oil refinery involving general plant maintenance, design, and working with engineers, draftsmen, contractors, plant forces, and shops; one year development involved with fuel tests on I.C. engines with respect to economy, octane requirement, and vapor lock. $600 a month. Prefers San Francisco East Bay area. Se-1026.

Designer, Machinery, Mechanical; 36; varied maintenance and machine-shop experience, some tool engineering and machine design, including work as mechanic, assembler, inspector and test. Prefers heavy machine or equipment manufacture and design. $600 a month. Prefers San Francisco Peninsula. Se-1218.

Senior Designer-Consultant, Mechanical; 69; 20 years' experience supervise, design power plants, oil refineries, magnesium plant; seven years' foreign experience. $7.50 per hour. Prefers San Francisco area. Se-551.

Sales Engineer, Heavy Construction, Mechanical; 38; heavy in sales promotion, technical product application proposal, and contract administration. Background in design, estimating, purchasing and subcontracting, process, and special equipment sales. $700-$800 a month. Prefers West Coast. Se-1160.

Production, Plant Engineer, Steel Fabrication, Mechanical; 35; ten years' production engineer, plant engineer, machinist, cost analysis, production problems, maintenance, design. $700 a month. Prefers San Francisco area. Se-1605.

Sales Engineer, Administration, Mechanical, Chemical, graduate mechanical; 27; four years' sales, design, development, administrative, product research in molded plastics, manufacturing. $650-$750 a month. Prefers San Francisco area. Se-1605.

Positions Available

New York Office

Applications or Product Engineer, 23-30, graduate mechanical or electrical, to perform, under direction, highly technical engineering duties primarily related to the design and application of small, high precision ball bearings; assist in compiling performance, application, and design data; investigate customer bearing-application problems. Minimum of one year's experience in an allied or same field. Must be U. S. citizen. $6500-$7500, depending upon education, experience, and potential. New England. W-891.

Methods Engineer, industrial or mechanical graduate, up to six years' experience, for methods improvement, manpower utilization, work measurement, and material handling in chemical-process plant. No supervisory duties. $7500-$9000. Ill. W-889(*b*).

Sales Engineer, at least ten years' field-sales experience covering plate-fabricated materials and heavy equipment in New York metropolitan area. $8000-$10,000, plus bonus. Headquarters, N. J. W-882.

Plant Engineer, mechanical or chemical-engineering graduate, equipment operation, maintenance, and installation experience in distilling or allied fermentation-process plants. $10,000-$12,000. Caribbean area. F-881.

Engineers. (*a*) Senior mechanical engineer, ten or more years' experience in engineering, approximately five of which have been connected with the design of pressure vessels, piping and solids conveying equipment, and chemical plant, or refinery layout. (*b*) Senior instrument engineer, minimum of five years' instrumentation experience, for work on the application, specification, and installation of process-instrumentation group. Salary open depending on education and experience. Va. W-863.

Program Manager, graduate mechanical, electrical, or aeronautical, five to ten years' experience, most of which has been spent in aerospace activities, with some experience in sales or marketing or a desire to get into these areas. Will handle entire marketing activities related to specific aerospace vehicle programs. Company pays fees, relocation, and interviewing expenses. $9000-$11,000, plus profit sharing. Western N. Y. State. W-860.

Senior Production Engineer, graduate mechanical, industrial, or electrical, five to six years' experience, to establish new and improve methods of production, tooling, layout assembly lines, for company manufacturing relays and other electrical components. $8000-$12,000. Northern N. J. W-841.

Plant Superintendent, 35-50, completely familiar with all phases of cabinet work and furniture production including scheduling, routine, machinery operation, cabinet assembly, finishing, use of materials, and other related functions pertaining to the manufacture of wood products. Will have full responsibility for all work operations of the plant. Base salary plus incentive. East. W-836(a).

Product Engineer, mechanical graduate, experience in metal and plastic fields including nylon-injection molding. $10,000. Central N. J. W-831.

Construction Engineer, degree in mechanical, chemical, or civil engineering, PE license extremely desirable. Should have at least five years' experience in project engineering in the construction of cryogenic, chemical, or petrochemical plants. Will be responsible for design procurement, construction, and start up of a single project. Approximately 50 per cent travel in U. S. To $9600, depending upon background. Headquarters, N. J. metropolitan area. W-827.

Sales Engineer, preferably training and experience in industrial-gas equipment and sales experience in capital equipment, good acquaintanceship with major chemical and food-processing industries on the East Coast, particularly the metropolitan New York area and down to and including Wilmington. Will sell carbon dioxide, nitrogen, hydrogen, and other industrial gas plants. Salary plus all traveling expenses. East Coast. W-821.

Export Manager for a company whose business is the design engineering and manufacture of industrial-gas plants for the manufacture of carbon dioxide, nitrogen, hydrogen, etc.; also designs and builds complete brewery and carbonated beverage CO_2 plants. Must be fluent in Spanish and have a working knowledge of Portuguese. Must know Latin America and Latin Americans. Will travel a minimum of three months to a maximum of six months a year, but not more than 30 to 45 days a trip. Headquarters, at present, Upstate N. Y. F-820.

Industrial Engineer, graduate, some experience, preferably for the woodworking industries. Must have considerable experience in incentive-wage installations. Considerable travel. About $12,000. Headquarters, New York, N. Y. W-819.

Mechanical Engineers. (*a*) Product designer, graduate, good working knowledge of mass-production processes and their capabilities; must be familiar with and have an appreciation for quality control. Will be responsible for redesign for most economical mass production; expedite pilot lot as proof of design feasibility; be responsible for an assigned product from design standpoint until it is in full production. To $9000. (*b*) Product-testing engineer, graduate, experience in operating parameters, such as force, stress, strain, pressure, velocity, acceleration, displacement, vibration, etc. Experience should include strength of materials, math, statistics of quality control, applied mechanics, and dynamics. Must have good working knowledge, both theoretical and practical, of testing apparatus used to measure the mechanical, physical, optical, and fluid properties of materials. To $9000. Mass. W-818.

Chief Methods and Process Engineer capable of directing six to eight process engineers in the development of special manufacturing processes and tooling; experience in screw, tube bending, heliarc welding, and brazing machines for aircraft industry. $10,000, plus. Company pays fee. Mass. W-814.

Engineers. (*a*) Field-sales manager experienced in selling pumps, valves, engines, steam specialties, or allied lines to consulting engineers, industrial, chemical, OEM, and government accounts. Must have an engineering-sales background; must be able to develop new accounts, train new and retrain sales personnel in new concepts and approaches, and a knowledge of modern marketing as it applies to engineered products. Travel about 70 per cent; possibly some foreign travel; ability to speak a foreign language desirable. Open. (*b*) Application engineer, graduate mechanical, background in industrial piping or stress-analysis experience. Will be trained in the application of expansion joints in piping systems to solve piping problems of all industries; 30 per cent travel; possibly some foreign travel; ability to speak a foreign language desirable. Open. Headquarters, Del. W-802.

Training Specialist, degree plus minimum of two years' training experience, to develop and establish individual and group training programs to meet the needs of both R&D and manufacturing personnel; assess training needs; administer a planned appraisal and counseling effort and serve as conference leader. Ohio. W-798.

Chief Engineer, graduate mechanical, good processing and materials background, to design for low-cost production. Will direct a group of 15 to 20 people in the design of equipment falling generally in the heat-transfer category. Experience in heat exchangers or thermodynamics, or as closely related types of equipment as possible. $12,000-$15000. East. W-795.

Mechanical-Project Engineer, graduate mechanical, MS preferred, eight to ten years' experience on the design of electromechanical mechanisms which are small, fast, close dimensioned. $14,000-$18,000. Mass. W-789.

Industrial Engineer, graduate industrial, at least five to ten years' experience in industrial engineering in a manufacturing plant with a significant part of experience in machine-shop and assembly-line operations. Will organize and direct activities of the Methods and Estimating Section. Areas of responsibilities will be: Plant layout, manufacturing engineering, cost analysis, etc. $9000-$11,000. Company pays fees, interview, and relocation expenses. Upstate N. Y. W-788.

Engineers. (*a*) Senior engineer, product design and/or development, graduate mechanical, at least eight to ten years' experience in product design and/or development in one or more of the following areas: Business machines, photographic equipment, microfilm equipment, graphic arts. Must have a consumer-product design background as opposed to machine or tool design. $10,000-$13,000. (*b*) Product designer or design engineer, degree or equivalent experience, at least five to eight years' experience in product design in one or more of the following areas: Business machines, photographic equipment, microfilm equipment, graphic arts. Must have concentrated board activity in consumer-product design. $8000-$10,000. Company pays fees, interview, and relocation expenses. Upstate N. Y. W-786.

San Francisco Office

Project Design Engineer, Hydropower, mechanical graduate, well qualified at design-consulting project level in large hydropower plant (gates, valves, penstock), strong mechanically. Engage in or review plans and specifications, deal with foreign subcontract design consultants and engineers. Possibly move to construction area as resident and deal with foreign contractor-builders. $17,500. England. Sj-6529.

Sales Engineer, Specialty Fabricated Steel Products, graduate mechanical, 30-45, eight or more years' sales experience, some sales administration. Background in selling instruments and controls, conveyer systems, elevators. Sell to government agencies, architects, and engineers. For a manufacturer. $850-$1000, plus. Western U. S., Alka., and Hawaii. Sj-5969.

Designer, Packaging Equipment, mechanical graduate, six years work on food-packaging systems and related hi-speed, continuous production equipage (wrap, cellophane, box, seal, fill) fluid, frozen, solids, powder; on new, modified, or repaired equipment. For mechanical division of a national foods firm. $8000-$10,000. San Francisco, Calif. Sj-6576.

Designer, Mechanical, graduate mechanical, advanced study preferred; senior mechanical heavy on stress vibration and deflection analysis and calculations, large roller bearings, gears, drive systems, back lash minimizing; weldment and casting-information background desired. For movable training apparatus on large saucer-type radio antenna. Other miscellaneous details of heavy machinery. For engineering builder. $800-$1200 a month. Company pays fee. San Francisco Peninsula. Sj-6600.

Designer, mechanical or electrical, licensed, Calif. registration preferred, more than five years consulting-office work on heating, ventilating, air conditioning, and other mechanical work for commercial, public, and industrial buildings; private and government. For a consultant. About $800 a month. San Leandro, Calif. Sj-6528.

Quality-Control Engineer, Plastics, mechanical or civil graduate, five to ten years out of school. Qualified in polyethelene, cellulose, or vinyl. Quality control, new products lab, work with manufacturing standards; involving high-temperature melting, extrustions, coating, may include flexigraph presses, air knife coating. $650-$850 a month up. San Francisco East Bay. Sj-6556.

Tool Designer, Small Parts, mechanical background, to 50, six years' plant layout, design tool fixtures, small parts manufacture; plan, advise draftsmen; knowledge metal fabrication, prepare sketches, layouts, final design, and drawings; direct draftsmen, check drawings, compute tolerances and adapt to manufacture, calculate complex mechanical problems, assist in making man-hours studies; design jigs, fixtures small parts, brazing, furnace, welding. For electronic device manufacturer. $575-$700 a month. San Mateo County, Calif. Sj-6261.

Industrial Engineer, Steel, graduate industrial or mechanical, to 25. Recent graduate, no experience, to do time, motion study, wage incentive, job evaluation, management survey. For a steel works (rolling and finishing). U. S. citizen. $550-$650 a month. South San Francisco, Calif. Sj-6558.

Field Aides, graduate mechanical, civil, electrical, or equivalent, two to a few years' experience in field construction, office, preferably on large military base; will assist in constructing, activation. Should be able to assist in some of the following: Quantities, costs, estimates, progress, production, records, reports, subcontracts, materials, expedite, work schedules, inspect, surveillance of work, locations, placing, layout, on sewers, water, streets or mechanical service, or electric power, light, distribution. Employer will discuss fee payment and relocation costs. Apply by letter, telephone, person. $500-$700 a month or more. Interviews in San Francisco; location Northwest U. S. Sj-6533.

Industrial Engineer, Business, graduate, several years' experience, preferably office papers (forms, procedures), time studies, method improvements, handling, purchasing office, and plant machinery layout. For paper manufacturer. $500-$650 a month. San Francisco East Bay, Calif. Sj-6542.

YARWAY news briefs

from **Yarnall-Waring Company**, *Philadelphia 18, Pa.*

BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD

YARWAY GUN-PAKT EXPANSION JOINTS ARE BEING SPECIFIED IN RECORD NUMBERS

These user-benefits tell why:

All over the country a rapidly-increasing number of expansion joint jobs on steam and high temperature water piping at utilities, industrial plants and institutions are being specified "YARWAY GUN-PAKT." Here's why:

TROUBLE-FREE SERVICE
Shutdowns are eliminated. Packing can be added *under full line pressure.* No vents. Joints never need repacking.

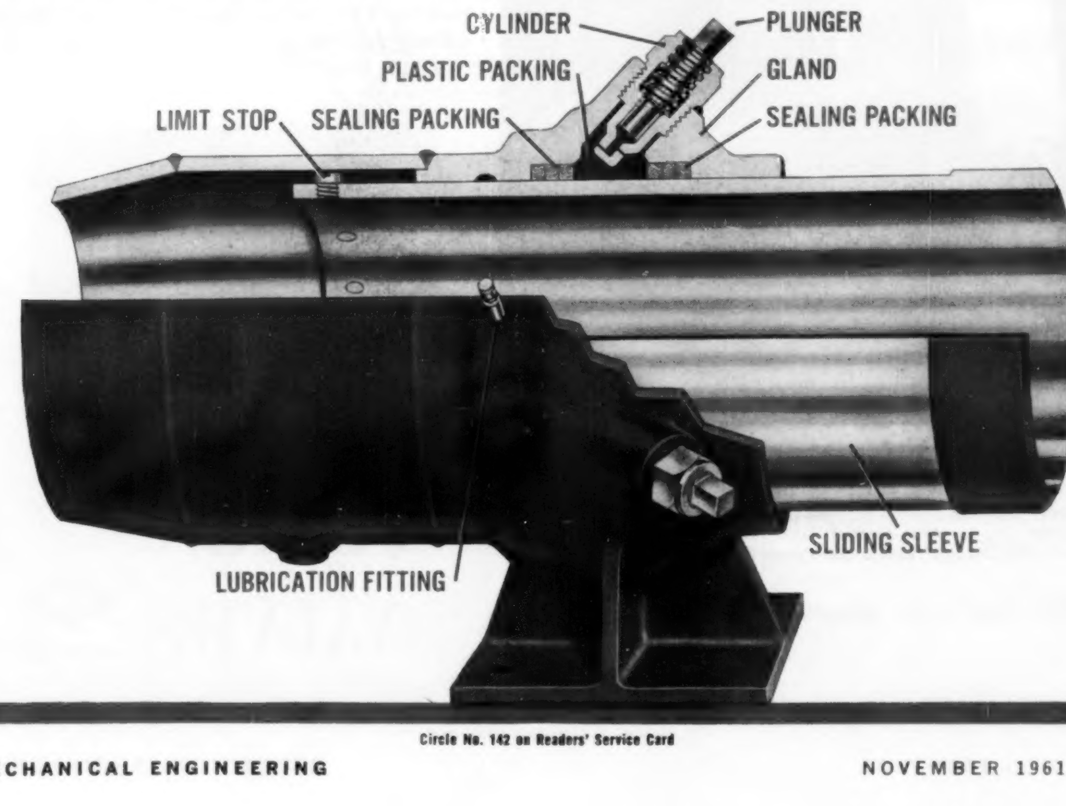
SIMPLIFIED DESIGN
Sectioned view (below) shows at a glance the simple, compact design. Provides easy accessibility, takes less space to install and maintain, needs smaller manholes, fewer joints per length of pipeline.

RUGGED DEPENDABILITY
All-steel construction, with durable, chromium-plated seamless steel sleeves. *No chance of metal fatigue.*

INTERNAL AND EXTERNAL GUIDES
Positive alignment of sleeve in stuffing box, *where it counts.*

MINIMUM MAINTENANCE
Never a shutdown for repacking—and records show an average of one manhour and 65 cents worth of packing added per joint per year. *Many Gun-Pakt Joints have been in service over 25 years with only this nominal maintenance.*

Why don't *you* investigate Yarway Gun-Pakt Joints by calling a Yarway Sales Engineer at one of the 20 Yarway offices located from coast-to-coast—or simply by writing for Bulletin EJ-1917.



YOUR

New Catalogs

LATEST INDUSTRIAL LITERATURE

GUIDE

Those in industry who are responsible for various phases of plant, machinery, and product design, production, operating and application engineering will find much to interest them in this NEW CATALOGS Guide. Here reputable manufacturers, most of whom have current advertising in MECHANICAL ENGINEERING and MECHANICAL ENGINEERS' CATALOG, offer to send you without obligation, their latest literature which is described on pages 141–169.

FOR convenience in locating catalogs about particular equipment, product or service, a list is given below in which the numbers refer to the catalog items beginning on page 141. This will aid you in locating something specific although a perusal of the entire list may disclose other items of more than usual interest to you.

This November 1961 insertion of NEW CATALOGS Guide replaces the regular "Keep Informed" Section for this issue. The "Keep Informed" Section will appear regularly again beginning with the next issue.

Make a selection and indicate on the coupon, page 140, by circling the numbers of the literature described and fill in the balance of the coupon completely, for no literature will be sent if firm connection and position are not given. Mail to—

MECHANICAL ENGINEERING
215 Wayne St., St. Joseph, Mich.

Help yourself to this useful literature—you incur no obligation when you return this coupon.

Distribution by us to students not included.

Catalog Index by Products

Continued on Page 140

Use Coupon on Page 140

***CATALOG ITEMS* Start on *Page 141* and Run to *Page 169* Inclusive**

YOUR

New Catalogs — LATEST INDUSTRIAL LITERATURE

GUIDE

Mail This COUPON Today

MECHANICAL ENGINEERING, 215 Wayne St., St. Joseph, Mich.

Date ....

Please send me without cost or obligation the literature indicated by the following circled numbers which appear in "Your NEW CATALOGS Guide" in the November 1961 issue. (Requests limited to 25 catalogs.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165
166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195
196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225
226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255
256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
271	272	273	274	275	276	277	278	279	280	281	282	283	284	285
286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315
316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
331	332	333	334	335	336	337	338	339	340	341	342	343	344	345
346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375
376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
391	392	393	394	395	396	397	398	399	400	401	402	403	404	405
406	407	408	409	410	411	412	413							

Firm Connection and Occupation Must be Given

(Service not Available to Students)

Name ....

Position ....

Company ....

Address ....

11-61

NOT GOOD AFTER JANUARY 31, 1962

CATALOG ITEMS Start on next page

Select desired catalogs by number. Requests limited to 25 catalogs.

YOUR

New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

Make use of this FREE LITERATURE SERVICE

A world of facts at your finger tips. Use coupon on page 140 for free catalogs you need.

1 PISTON, SEALING RINGS

Koppers Co., Metal Products Div.—A 24-page brochure illustrates and describes American Hammered piston and sealing rings for various types of industrial applications. Also available are four-page folders on conformable oil rings, marine piston rings, chrome-plated piston rings, piston rings for air and steam forging hammers, Teflon rings, railroad piston rings, and an eight-page brochure on metallic sealing rings.

2 PUMPS

Pump & Hydraulic Div., Fairbanks, Morse & Co.—A 12-page catalog outlines the capacity and pressure ranges of all the company's pumps, indexed according to pumping requirements in terms of gallonage, pressure, corrosive problems, solids passing ability, etc. The pumps handle all types of liquids under a wide range of operating conditions, from delicate fruit handling pumps to snow-making machine pumps to petroleum industry "pot-pumps" to LP gas transfer pumps.

3 ROLLER CHAIN

Acme Chain Corp.—Catalog No. 8 covers dimensions, list prices, engineering data, design suggestions for roller chain, double pitch chain attachments, cable chain, AL series and BL series, stainless steel chains, chain couplings, conveyer chains, bakery chains, and radius chains.

4 STEEL TUBING

American Cast Iron Pipe Co.—Illustrated 64-page catalog describes special products division facilities, the centrifugal spinning process, its advantages and illustrates versatility of application of tubes. It contains tables, technical data, engineering information for stainless and carbon steel tubes 2.25–52 in. od.

5 FLAME DETECTOR

Bailey Meter Co.—Flame detector senses presence of a flame and operates an internal relay for alarms, tripping circuits, etc., or transmits a signal for use with an information system. It is described in Product Specification E66–2. The device monitors fuel burning equipment using gas, oil and fuels in combination, and responds only to flame under surveillance.

6 HINGED CLOSURES

Tube Turns Div. of Chemetron Corp.—Bulletin TT1034 describes a line of hinged closures that are said to provide a swift, safe, and economical means of blanking off pipe line ends and tank or vessel openings where frequent access is required. Contains technical information and dimensional data. Installation photographs indicate wide range of uses in many industries.

7 MATERIAL LEVEL CONTROL

Flo-Tronics, Inc.—Catalog sheet presents information on Model L400 and L400A Flo-Level, an electronic unit for determining the presence or absence of material at a selected level in a bin, hopper, storage tank, or similar container. The device is designed to fail safe in event of failure of any part of the unit.

8 FLEXIBLE SHAFT ASSEMBLIES

F. W. Stewart Corp.—Illustrated catalog describes Circle Ess flexible shaft assemblies in four cable sizes, 0.130, 0.150, 0.187, and 0.250 in. in monodirectional or bidirectional types. Choice of three to four end fitting combinations are offered on either end of the assembly.

9 COPPER TUBING HANGERS

Grinnell Co.—A 12-page catalog, CTH-56, covers hangers and supports for copper tubing. All hangers are copper plated and accurately sized to fit standard copper tubing. Data is also included on packaged quantities.

10 BUCKET ELEVATORS

Jeffrey Mfg. Co.—Catalog 950,96 pages, covers all aspects of materials-handling elevator equipment. It introduces special cement mill elevator, and contains drawings, diagrams, specification charts, installation photographs.

YOUR *New Catalogs* GUIDE

11 OIL FILTERS, STRAINERS, OILING SERVICES

Wm. W. Nugent & Co., Inc.—Seven bulletins. No. 6 illustrates and describes Nugent pressure strainers; No. 7 gravity filters; No. 7A pressure filters; No. 8 tanks, pumps, shaft oilers; No. 14F oiling and filtering systems for turbines, paper mills, steel mills, pumps, compressors; No. 15 oiling devices; No. 16 sight feed valves, multiple oilers, flow indicators, sight overflows, and compression union fittings.

12 ANTI-FRICTION BEARINGS

S K F Industries, Inc.—Catalog 450 provides latest technical information on S K F ball and roller bearings, pillow blocks, flanged housings, and accessories; Atlas balls, and Tyson tapered roller bearings. Engineering data includes information on permissible load ratings, cleaning bearings, bearing selection, twelve useful tolerance tables, and millimeter-inch conversion tables.

13 HOSE, FITTINGS

Flexonics—Catalog No. 220 describes metal hose and fittings, with data tables, information on computing hose length, installation instructions, hose construction, etc. Interlocked and corrugated metal hose with re-usable and permanent fittings.

14 GAS-TURBINE-DRIVEN COMPRESSOR

Solar Aircraft Co.—A line of centrifugal gas compressors, developed for use with gas-turbine engines, is described in a four-page bulletin. Included are cross-section views, dimensional drawings and performance data.

15 HEAT EXCHANGER

Link-Belt Co.—The Roto-Fin heat exchanger, designed for high-volume cooling or heating of bulk materials, is described in six-page Folder 2911. Diagrams and photographs illustrates the simple, compact design of the Roto-Fin, which is a rotating drum with a series of flat, dual-purpose hollow fins or "cells" lapped consecutively around the inside of the drum to form an Archimedes spiral. Typical applications illustrated include flue dust, finished cement, gypsum plaster, foundry sand, sugar, copper concentrates, sewage sludge, fluid coke, and salt.

16 BEARING CUPS, CONES

Timken Roller Bearing Co.—An illustrated brochure tells how the company's continuous high-speed production methods at its Bucyrus, Ohio, plant is holding down bearing costs and explains how manufacturers can benefit from these economies. Includes price index history demonstrating what these economies mean to the automotive industry. Back cover chart shows the 30 bearing cups and cones.

17 DIESEL ENGINES

Nordberg Mfg. Co.—Power Chief four-cycle diesel and gas engines available in one, two, and three-cylinder units and a horsepower range of 8–54, for continuous duty or standby service, are described in 12-page Bulletin No. 239B. Power Chief diesel engine generator sets, available in all standard voltages, ac and dc, are also described.

18 BEARINGS AND BARS

Bunting Brass & Bronze Co.—Catalog 158 covers standard stock cast bronze bearings and bars, sintered powdered oil-filled bearings and bars, and aluminum bar stock bearing material. Catalog 32 describes nylon rod, tubes, and plates. Catalog 258 includes stock sizes of electric motor bearings.

19 REMOTE LIQUID LEVEL INDICATORS

Yarnall-Waring Co.—Yarway Bulletin RI-1825 describes remote liquid level indicators for pressures up to 700 psi. For use in indicating boiler water levels, levels in feed water heaters, deaerators, heat exchangers, open tanks, etc. Indicator is operated by the liquid itself, yet indicating mechanism is never under pressure.

20 POWER TRANSMISSION

Morse Chain Co., Div. of Borg-Warner—Brochure SF-60 includes, in a 16-page capsule form, the parts manufactured and distributed by the company, which is a leader in the power transmission field since 1893. Specifications, graphs, product illustrations, and application photos are included.

YOUR

New Catalogs GUIDE

21 AUTOMATIC PRESSURE CONTROLS

A. W. Cash Valve Mfg. Corp.—An 84-page catalog offers information on relief valves, safety devices, pressure regulators, hydronic heating valves, refrigeration controls, and protective equipment. The catalog contains capacity and spring range charts, installation, and engineering information.

22 CABLE ISOLATORS

Aeroflex Laboratories, Inc.—A four-page bulletin describes a new concept in shock and vibration isolation. Aeroflex cable isolators achieve isolation in all three planes. They will not bottom out even under severe overloads and are stable over a temperature range of −100 F to over +500 F.

23 MODULAR-DESIGN BOILER

Combustion Engineering, Inc.—Bulletin VU-60-1 covers design, installation and performance of C-E VU-60 boilers (100,000 to 250,000 lb per hr). Standardized modules permit a wide range of boiler proportions for a given capacity without requiring custom engineering.

24 SYNTHETIC FIBER FELTS

American Felt Co.—Mechanical, physical, and chemical properties of Teflon, Polypropylene, Dacron, Dynel, Rayon, Orlon, and Nylon felts are tabulated in an eight-page Technical Bulletin, No. 4-61, describing various types of felt constructions and typical uses. Included are felts for air and liquid filtration, gaskets, seals, wicks, insulation, cushioning, padding, and others.

25 REVERSE FLOW CONDENSERS

C. H. Wheeler Mfg. Co.—Eight-page catalog describes the advantages of "self-cleaning" reverse flow steam condensers. Diagrams show how the principle works in both divided and non-divided water box condensers. Typical vacuum record charts are included.

26 WATER SOFTENERS

Permutit Co., Div. of Pfaudler Permutit, Inc.—Bulletin 4696 describes high capacity standard commercial industrial water softeners Model BD, MQ, and EQ series. Size Range: Flow Rate 17.5 gpm to 100 gpm—Capacity 120,000 grains to 1,380,000 grains. Includes details on operation, performance, and specifications.

27 COMPRESSORS

York Corp., Subs. of Borg-Warner Corp.—Bulletin M 220.05-S describes the York Series T Turbomaster compressor, a heavy duty, single stage centrifugal compressor designed for applications handling commercial refrigerants. It is available in seven models and can be driven by electric motor, steam turbine, gas turbine, or gas engine.

28 CHAINS, SPROCKETS

Diamond Chain Co. Inc.—Catalog No. 760 covers the firm's standard products and gives specific engineering data on chain selection, horse power ratings, chain and sprocket recommendation sizes.

29 TEMPERATURE TRANSMITTERS

Foxboro Co.—Bulletin 13-17B describes the type 12A temperature transmitter, which features compact construction, force-balance operation, and—to sustain measurement accuracy—automatic compensation for ambient temperature and pressure changes. Included are detailed specifications, description of operating principle, and table of temperature ranges.

30 FLEXIBLE COUPLINGS

Ajax Flexible Coupling Co.—Bulletin 8A/AJ describes and gives detailed dimensions on Ajax Rubber Cushioned, Sleeve Bearing and Dihedral Flexible Couplings for power transmission purposes. Photographs and general information on Ajax vibrating conveyors, screens, feeders and packers are also included.

31 FRESH AIR SUPPLY HEATERS

L. J. Wing Mfg. Co., Div. of Aero Flow Dynamics, Inc.—Bulletin GFAS-60 describes Wing direct-gas-fired fresh-air-supply heaters of unitized construction, factory pre-wired and piped ready for installation. They are made in five sizes suited for wall or roof inlet and offer up to 50,000 cfm and 4,500,000 Btu per hr output.

YOUR

New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

32 MECHANICAL DUST COLLECTORS

Industrial Div., Aerotec Industries, Inc.—Illustrated Bulletin AI-103 discusses a line of mechanical collectors. It details the new Aerotec 10-in. cast iron Design 104 and traces application of Aerotec tubular centrifugal-type collectors ranging from 1/2 in. to 3 in. in diameter for industrial use, and the 5-in., 6-in., and 10-in. tubes for fly ash collection. A chapter also describes Aerotec large-diameter cyclones.

33 STRUCTURAL INSULATING PANELS

Philip Carey Mfg. Co.—Form No. 6301 provides data on a rigid, structural material that also insulates walls, roof decks, partitions. It is made by bonding asbestos-cement board to both sides of a specially processed asphalt-treated insulation board. The material is described as lightweight, water-resistant, approximately 60 per cent light reflectivity, won't rust nor rot and needs no preservative treatment or painting.

34 VIBRATION TEST MACHINES

All American Tool & Mfg. Co.—Catalog F describes five new models of vibration fatigue testing machines equipped with electronically controlled drive motors and automatic range selector for variable acceleration control. Units are said to provide infinite frequency control within the range of 5 to 100 cps.

35 HEAT EXCHANGER TUBING

Babcock & Wilcox Co., Tubular Products Div.—An eight-page brochure, TB431, introduces "Lectrosonic" heat exchanger tubing. It details manufacturing and testing procedure, and points out features.

36 BOILER SERVICE VALVES

Everlasting Valve Co.—Bulletin describes the Everlasting Quick-Opening and Slow-Opening Straightway Valves, Angle Valves, Y-Valves, and Duplex Blow-Off Units, with specifications, materials of construction, and dimensions of each type. Illustrations include details of design, sectional and exploded views, and explanations of operation of the valves. The bulletin also describes Everlasting Valves for fire protection.

37 STEAM TRAPS

Armstrong Machine Wks.—An enlarged 48-page manual and steam trap catalog includes open float and thermostatic traps, pipe strainers to 8 in. in steel and semi steel, useful steam pipe sizing tables. Fundamentals of good trapping, trap selection, installation, testing, trouble-shooting, and repair are discussed.

38 GENERAL PURPOSE COMPUTERS

Bendix Computer Div., Bendix Corp.—Brochures describe and illustrate the small-to medium-scale Bendix G-15 and the readily-expandable, transistorized, medium- to large-scale Bendix G-20 general purpose digital computers, for use in engineering, scientific, statistical, and data processing applications. Descriptions cover central processor, accessories, programming, and specifications.

39 SURFACE HARDENING STEELS

The Chapman Valve Mfg. Co.—Bulletin describes Chapman's process for surface hardening alloy steels. Process known as NI-20 is claimed to reduce time cycle requirement to produce greater case depths and higher wear resistance. Bulletin also provides new technical data on Chapman's malcomizing process.

40 INCINERATOR STOKER

Detroit Stoker Co.—Bulletin 701 describes the Detroit Reciprocating Grate Incinerator Stoker, for municipal and industrial garbage and refuse incinerators in capacities from 900 lb per hour up to 25,000 lb. The unit is said to cut installation and operating labor costs.

41 CONTROLS AND GAGES

F. W. Dwyer Mfg. Co.—The complete gage and control catalog contains illustrations, prices, and full details on The Dwyer Magnehelic gage, manometer, air velocity meters, air filter gages, pitot tubes, pressure-actuated switches, flowmeters, combustion testing instruments, conversion curves and other engineering data.

42 STROBOSCOPE

General Radio Co.—A new white-light Strobotac stroboscopic tachometer is described in detail in six-page bulletin. The Strobotac is claimed not only to make the measurement of speed a simple operation, but also allows observation of operating machine parts in apparent slow motion. Many applications are illustrated.

43 STAINLESS AND HIGH ALLOY PIPE AND TUBING

Trent Tube Co., Subsidiary of Crucible Steel Co. of America—A 48-page manual detailing the complete operation of Trent Tube, manufacturers of Contour Trent Tube, manufacturers of Contour Trentweld, stainless steel and high alloy pipe and tubing. Included is information on Tubing Classifications—plus charts and tables applying to each class. Corrosion characteristics, weights, properties of alloys and conversion tables.

44 OPERATIONAL AMPLIFIERS

George A. Philbrick Researches, Inc.—A 28-page booklet, "Applications Manual for Philbrick Octal Plug-In Computing Amplifiers," covers the theory, performance, and applications of differential operational amplifiers. Many specific uses are described, covering a wide range of circuits from simple inverters to complex multivibrators.

45 TECHNICAL BOOKS

Lefax Publishers—A revised catalog covers pocket size technical data books. The books cover every field of engineering, including aeronautics, air-conditioning, automotive engineering, diesel engineering, home heating, machine design, machinists' data, mechanical drawing, mechanics of materials, metals, piping data, power transmission machinery, steam engineering, thermodynamics tables and charts, general mathematics, five-place trig. and log. tables.

46 SUPER REFRACTORIES

Carborundum Co., Refractories Div.—"Properties of Super Refractories," twenty-four pages, covers latest data on super refractories including newly developed compositions for specialized applications. Re-frax silicon-nitride bonded silicon carbide refractories which can be produced in intricately designed shapes to close dimensional tolerances is described. Chemical analysis and physical property charts are provides on all materials.

47 OIL SEALS

National Seal Div., Federal-Mogul-Bower Bearings, Inc.—Catalog 61-B gives engineering application and selection data on new line of standard National oil seals. The catalog lists 3500 different sizes and types.

48 TIMERS

Heuer Timer Corp.—Over 100 timers are described in a stopwatch selection guide. Complete data and specifications on construction, method of operation, size, and reading are given for each timer.

49 CONTROLLED ATMOSPHERE TEMPERING UNITS

Ipsen Industries, Inc.—Bulletin D-61 shows a typical tempering furnace in cross section. A table of specifications describes a range of furnace sizes with oil quench and with atmosphere quench.

50 PACKAGE WATER TUBE BOILER

E. Keeler Co.—A 10-page catalog on water tube package boilers contains illustrations and data on a unit available in capacity range of 6000 to 60,000 lb-steam per hour.

51 GAGES AND THERMOMETERS

Marsh Instrument Co.—Catalogs No.76-G and 76-T describe in detail a wide line of industrial gages, needle valves, and thermometers. The catalogs are fully illustrated, including cut-away photographs and enlargements of internal parts. They cover also gage accessories, specifications including line drawings and dimensional tables, and templates covering every size and pattern.

YOUR

New Catalogs GUIDE

52 PLUNGER TYPE FASTENER

Hartwell Corp.—An eight-page bulletin describes the Nylatch push-pull plunger-type fastener designed for rapid fastening in metals, wood, and synthetics. This bulletin gives details on test information concerning grip, tension load, flexibility, and versatility of this type of fastener, complete with procurement information.

53 HIGH-STRENGTH STEELS

United States Steel Corp.—A 174-page manual discusses the essential principles of structural design and contains numerous formulas, charts and tables to assist in designing, for high-strength steels. The book covers engineering considerations and fundamental characteristics of high-strength steels, design considerations, working unit stresses, tension, compression, shear, stresses in beams, deformation and deflection.

54 PUMPS & SEPARATORS

Kraissl Co.—Index Bulletin A-1803 gives an abstract of most Kraissl products, with bulletin numbers of brochures giving a complete description of each. A recent bulletin, A-1966, covers Kraissl air pumps for sewage ejector service.

55 PRESSURE CODE CHART

Missouri Boiler & Tank Co.—A wall chart provides a quick reference guide to ASME Boiler and Pressure Vessel Code (Section VIII). The chart illustrates some of the types of pressure vessel construction provided for under Section VIII, and furnishes direct references to the Code rules that apply.

56 SELF-LUBRICATING BEARINGS

Lubrite Div., Merriman Bros., Inc.—Manual No. 56 is a 24-page book with technical data and specifications about Lubrite self-lubricating bushings, bearings, washers, and expansion plates for use in machinery, industrial equipment, hydro-electric projects, missile and atomic energy applications, and high temperature applications.

57 AIR CONDITIONERS

Modine Mfg. Co.—Bulletin 760 illustrates and describes a new line of self-contained, through-the-wall room air conditioners. Units utilize a fully hermetically sealed refrigerant cycle combined with heating coils for connection to hot water or steam systems. Models also available with electric heating element.

58 PNEUMATIC CONVEYORS

National Conveyors Co.—A four-page bulletin, P-1-P, describes pneumatic conveyor systems designed for handling plastic pellets at both the producing and finishing plant. These systems can be provided for any type of plastic pellet or powder suitable for pneumatic conveying, at rates ranging from 2000 to 100,000 lb per hour.

59 PIPE HANGERS

National Valve & Mfg. Co.—Bulletin 157 gives specifications for Counterpoise hangers, designed to provide a constant load supporting capacity for piping systems subject to vertical movement caused by expansion and contraction of piping with temperature changes. Levelglide hangers, which permit horizontal movement of piping systems, also are described.

60 TEMPERATURE REGULATORS

OPW-Jordan Corp.—Eight-page Catalog J180-1 describes the line of sliding gate regulators. Sizes are 1/4 to 6 in. Self-operated, pilot-operated, and combination temperature and pressure regulators are described.

61 SELF-ALIGNING COUPLINGS

Koppers Co., Metal Products Div.—A 16-page brochure describes principles and features of Fast's self-aligning couplings. Illustrates and describes each available standard and special model. Also available are four-page folders on Model B, forged steel, cast steel, mill motor flex-rigid and breaking-pin Jordan couplings.

62 CONTROLLED CAPACITY PUMPS

Blackmer Pump Co.—Bulletin 600 describes "Vari-Flo" controlled capacity rotary pumps. Simple, unique mechanical principle permits "dialing" of flow rates anywhere from zero to 100% capacity without changing pump speed or direction. Applications: versatile, fast handling of liquids at varying flow rates or viscosities.

YOUR *New Catalogs* GUIDE

63 STEEL GEARS

Alco Products, Inc.—Bulletin points out that fabricated gears using rims of Alco Hi-Qua-Led steel are less expensive than cast gears, but are stronger, tougher, and more fatigue resistant. Hi-Qua-Led forged and rolled gear blanks are available in any steel analysis, from 18 to 160 in. od and to 24 in. wide.

64 MATERIALS HANDLING SYSTEMS

Allen-Sherman-Hoff Co.—Catalogs and data sheets describe Econo-Ash pneumatic handling systems for small coal-burning plants, Ashvac pneumatic ash handling systems for medium size plants, A-S-H hydraulic ash handling systems for utilities, and A-S-H pneumatic materials handling systems for various applications. Literature includes engineering charts and technical data, design, operation, and dimensions.

65 PURIFIERS, MIST EXTRACTORS

V. D. Anderson Co.—Bulletin 803 itemizes principal applications of purifiers which remove liquid, solid and dust entrainment from gases and vapors. Information on internal, receiver and line type separators, mist extractors and scrubbers is included. Exhaust heads and high pressure purifiers designed to withstand pressures to 15,000 psig are also covered.

66 ELECTRIC SWITCHES

Cherry Electrical Products Corp.—A 20-page, three-color catalog covers the line of precision, snap-action Cherry switches including light force, miniature, enclosed and open switches. Each switch type is dimensioned by an engineering drawing, all operating characteristics are listed and the many variations of each type are illustrated.

67 WATER CONDITIONING EQUIPMENT

Cochrane Div., Crane Co.—Bulletin ADC 15-1002-461 summarizes water conditioning equipment, deaerating feedwater heaters, steam specialties, shell and tube heat exchangers, and cast iron cooling sections.

68 CYLINDER ACTUATORS

Conoflow Corp.—Data sheet describes the line of Series 50 Cylinder Conomotor actuators. The pneumatic actuator is used for precise proportional positioning of many types of processing equipment. Data Sheet 102 describes the operation and versatility of the Series 50 actuator. Complete specifications are listed and application examples illustrated.

69 LUBE AND SEAL OIL CONSOLES

Engineer Co.—Folder illustrates lube oil pumping and cooling units for lube oil singly or in combination with sealing oil at different pressures, operated by automatic control. Designed for safety and accessibility of all parts for inspection or manual adjustment.

70 CAMS

Ferguson Machine Co.—Catalog No.903 discusses cam design theory. Selection tables and selection graphs are presented for standard and semi-standard cams. Barrell cams are included as well as plate and face types.

71 CONTROL VALVES

Fisher Governor Co.—"Control Valves" is a new bulletin describing Fisher pneumatic diaphragm and piston actuators and a wide variety of valve body assemblies, ratings, and accessories. A 20-page specifying section contains information necessary for selection of a control valve.

72 NON-CLOG PUMPS

Chicago Pump, Hydrodynamics Div., Food Machinery & Chemical Corp.—A new 16-page bulletin, 124-G, is said to offer a simplified, practical approach to vertical nonclog sewage pump selection. The bulletin covers pumps for sewage, sump, and storm water pumping with capacity ranges to 5000 gpm, heads to 105 ft.

Fill in and mail the coupon on page 140 without delay.

YOUR

New Catalogs

GUIDE

73 HIGH PRESSURE WASHER

John Bean Div., Food Machinery and Chemical Corp.—The high pressure Aquablast washer is described in a bulletin. With pressures of up to 600 pounds per square inch or more, one man can handle a volume of cleaning work. The Aquablast is used as a heavy duty, all purpose washer in the ready-mix concrete industry, in canning factories for cleaning floors and cannery equipment and in many other industries.

74 HIGH TEMPERATURE WATER GENERATORS

International Boiler Works Co.—A 16-page Bulletin 1600, describes "International-LaMont" high temperature water generators. Engineering data section gives comparisons between HTW and high pressure steam systems along with cost considerations. Typical pressurization and pumping arrangements are discussed.

75 CEMENTED CARBIDES

Kennametal Inc.—A 28-page booklet illustrates by examples how the use of Kennametal and Kentanium increases productivity and reduces cost in many different industries; lists properties and typical applications of Kennametal, Kentanium, refractory carbides, heavy tungsten alloys, niobium, and tantalum.

76 AIR-GRAVITY CONVEYOR

Kennedy Van Saun Mfg. & Eng. Corp.—Bulletin 58-K illustrates and describes Air-Float conveyor for air-gravity conveying of dry free-flowing materials. Of principal interest to the cement, lime, and chemicals industries, the unit uses an exclusive porous plate for the conveying surface.

77 INDUSTRIAL DOORS

Kinnear Mfg. Co.—Bulletin No. 114, a 36-page catalog, illustrates and describes the firm's line of doors and accessories for industrial use. Specifications on types and sizes of various doors are included, along with application information.

78 GEARED MOTORS

Merkle-Korff Gear Co.—An eight-page catalog illustrates and describes basic models of spur gear cases with various combinations of drive motors, including induction, synchronous, and series types. Dimensional diagrams, speed vs. torque ratings, and other pertinent application data are included.

79 SNAP-ACTION SWITCHES

Micro Switch Div., Minneapolis-Honeywell Regulator Co.—A 20-page catalog, 104, covers a representative selection of the complete Micro Switch line of precision switches for industrial, commercial, data processing, airborne, and electronic applications. Over 200 items are covered including toggle, oiltight limit, high-temperature, miniaturized, pushbutton, hermetically sealed, door interlock, explosion-proof, electronic circuit, rotary selector, pulse, proximity, and mercury switch types.

80 SCREW THREAD GAGES

O-VEE Gauge Co.—Catalog describes a line of screw thread measuring gages which measure the pitch diameter of screw threads without the need for calculations or reference to tables. They are said to meet the latest specification for single element gaging designed to improve quality of screw thread production.

81 HEAVY DUTY COMPRESSORS

Pennsylvania Pump & Compressor Co.—Bulletin 360 covers single stage, high speed, fully pressure lubricated, vertical or horizontal, water cooled, heavy duty air compressors. Available in sizes from 10 to 100 hp and for pressures to 150 psig.

82 TECHNICAL BOOKS

Ronald Press Co.—A package of descriptive circulars about engineering books covers mechanics, aerodynamics, air conditioning, thermodynamics, hydraulics, linear programming, materials handling, nuclear radiation engineering, nondestructive testing, and other subjects.

83 RING LOCKED FASTENERS

Rosan, Inc.—Literature describes studs, inserts, bolts and nuts which are locked against rotation and joint looseness resulting therefrom by the firm's serrated locking ring. Ring locked fasteners are available for nonferrous as well as certain ferrous materials.

YOUR *New Catalogs* GUIDE — LATEST INDUSTRIAL LITERATURE

84 CORROSION RESISTING PLASTIC

Joseph T. Ryerson & Son, Inc.—Technical Bulletin 80-3 provides engineering data on Ryertex-Omicron PVC plastic. Included are tables of properties, advantages, chemical resistance to various media, fabricating instructions, pipe installation suggestions, bar, pipe, and sheet sizes, and illustrations of applications.

85 HIGH PRESSURE NEEDLE VALVES

Dragon Engineering Co.—Catalog shows a complete line of needle valves, globe and angle types. Sizes are from 1/8 to 1 in. with pipe or tubing connections. Also covered are remote control diaphragm valves, gage glass fittings, and special valves.

86 GASKET MATERIALS

Garlock, Inc.—A 24-page bulletin, AD-190, details rating for 120 fluids and gases. Technical data charts appear with description of Garlock's 65 standard gasketing materials.

87 TEMPERATURE CONTROLS

Fenwal Inc.—Detailed folders describe devices for temperature detection, indication and control. Included are Thermoswitch and snap action local controls, remote bulb and capillary units, Detect-a-Fire and electronic thermistor controllers.

88 MINIATURE AND INSTRUMENT BALL BEARINGS

New Departure Div., General Motors Corp.—A 48-page booklet illustrates and describes ball bearings for use in precision instruments. Tables, charts, and diagrams show the various series of miniature bearings in a wide range of applications. Code: M.I.

89 SYNTHETIC RUBBER

B. F. Goodrich Chemical Co.—Brochure "Hycar Rubber," 8 pages, describes B. F. Goodrich Hycar rubbers and their properties, using text and tables. General applications and uses are suggested for the different types and blends available.

90 SHELL AND TUBE HEAT EXCHANGERS

Griscom-Russell Co.—Bulletin 101 gives design details, acceptable modifications, setting plans, stacking dimensions, tube counts and surface, and shell side flow area data.

91 DRYERS, COOLERS, HEATERS

Hardinge Co., Inc.—A 24-page catalog, 16-E, covers Ruggles-Coles dryers, heaters, and coolers. The catalog includes new material on fundamentals of drying, selection of proper drying equipment, and drying economics. Illustrated with photographs and sketches showing distinguishing features of the Ruggles-Coles direct and indirect type dryers, water, air-cooled rotary coolers, etc.

92 CYLINDER PACKINGS

E. F. Houghton & Co.—Catalog describes Rex-Syn cup packings made of plastic resin and elastomer. The catalog also gives sizes and results of several field tests.

93 FIRING EQUIPMENT

Iron Fireman Mfg. Co.—Form 6503 is a general catalog of commercial and industrial gas, oil, and coal firing equipment. Basic considerations are discussed and an index and selection chart is included. Oil burners, gas burners, and dual fuel burners are covered, together with coal stokers.

94 PLUNGER PUMPS

Kobe, Inc.—Bulletin describes high pressure triplex plunger pumps and their applications. Outstanding design feature is lap-fitting plungers and liners which are said to eliminate packing maintenance. Continuous duty ratings to 20,000 psi and to 60 hp. Range of temperature is +1000 F, and −320 F.

95 VIBRATION, NOISE CONTROL

Korfund Co.—Eight-page booklet K4H gives engineering specifications and performance data for 27 types of products for the control and measurement of machinery vibration, shock, and noise. Installation photos show a variety of equipments.

96 BALL RADIAL BEARINGS

Kaydon Engrg. Corp.—Bulletin S-141 gives design data on Reali-Slim "CP" ball radial bearings. Includes a listing of ninety sizes from 4-in. to 12-in. bore with 1/4-in. to 1-in. width and cross section in all bore sizes. Other data include capacities, cross section drawings, shaft and housing sizes, bearing internal clearances, mounting data, and list prices.

97 EXPANSION JOINTS

Marquette Coppersmithing Co.—An eight-page, illustrated release in tabular format on Omega metal bellows-type, expansion joints, covers allowable deflections and lengths of the Omega joint.

98 DRAFTING FURNITURE & EQUIPMENT

Mayline Co.—Catalog 11 illustrates and describes a line of drafting furniture and equipment, including adjustable and counter-balanced drafting tables. Space-saving drawer combinations for all 4-post tables are described, and plan files are shown in both wood and steel.

99 STEAM GENERATOR

Mears-Kane-Ofeldt, Inc. Div., S. T. Johnson Co.—Bulletin 8-C covers new horizontal steam generator available in 6 1/2, 15, 25, and 33 hp sizes for use with gas, oil, or combination gas or oil.

100 STEAM TURBINES

Terry Steam Turbine Co.—Bulletins in looseleaf form which cover a complete description of Terry solid wheel turbines with cross section drawings of typical units for both moderate and high steam pressure conditions; a description of the Terry axial flow impulse, both single stage and multi stage; Terry gears which are used for speed increasing and speed reducing.

101 DESUPERHEATER

Copes-Vulcan Div., Blaw-Knox Co.—Bulletin 1037 illustrates and describes a variable-orifice desuperheater that holds reduced steam temperatures constant within 20 ft of outlet, even over load range as wide as 50 to 1. The unit needs no atomizing steam, no long downstream piping runs. Permanent pressure loss is 3 to 4 psig on all flows.

102 FLEXIBLE METAL HOSE

Allied Metal Hose Co.—A 12-page manual on flexible metal hose pipe connectors includes analysis of connectors, their application, design, engineering, and handling; interpreting engineer's specifications, a check-list for optimum service, pressure-and-flexibility-criteria reference table, and pressure-temperature-correction-factor table.

103 FERROUS FORGINGS

American Brake Shoe Co., AmForge Div.—Illustrated 28-page booklet describes forging facilities and products. These include drop, upset, and press forgings. Case histories of savings through use of AmForge facilities are detailed.

104 PRESSURE REGULATORS

American Meter Co.—Bulletin 130 covers Series 100 and 200 pressure regulators used for reduction, relief and back pressure applications in transmission, distribution and industrial installations where accuracy, sensitivity, and reliability with minimum maintenance are important. Maximum inlet pressure is 1200 psi; maximum outlet pressure 150 psi, or 600 psi with pilot loading. Bulletin 131 describes Series 300 low-pressure regulators, designed for similar application on low-pressure systems. Maximum inlet pressure is 400 psi, maximum outlet pressure 14 in. w.c.

105 SLINGS

Union Wire Rope, Sub. of Armco Steel Corp.—"Tuffy" Sling Handbook gives complete specifications on the 13 types of "Tuffy" slings, as well as specifications for sling and wire rope fittings and an engineers' notebook on various sling constructions.

YOUR *New Catalogs* GUIDE

106 OPTICAL GAGE

Bausch & Lomb Inc.—The DR-25B optical gage, offering absolute measurement directly to one ten-thousandth inch, is said to be operable by technicians without special training and to be constructed so that it can be used in production areas without being affected by vibrations from adjoining machinery.

107 BIN OUTLET DESIGN

Bin-Dicator Co.—Catalogue describes a new concept in bin or hopper outlet design. The Bin-Dicator hyperbolic outlet provides fast, free and uniform flow of most difficult to flow granular and lump materials. Catalogue lists standards in outlet sizes and materials of construction and explains why probing, hammering, or vibrating is not necessary.

108 FANS, BLOWERS

Bayley Blower Co.—Air conditioning fans and ventilating fans, including airfoil, backward inclined and forward curve, industrial exhauster, industrial high pressure blowers. Write for bulletin.

109 COPPER DRAINAGE TUBE

Chase Brass & Copper Co.—Publication G-23, 20 pages, tells the story of the economy of copper tube and solder-joint fittings for soil, waste, and vent lines, gives roughing-in dimensions for drainage fittings.

110 CUSTOM GEARS

Cincinnati Gear Co.—Illustrated folder describes and shows examples of types of gears produced to individual specifications only for all types of machinery and products. Gear types listed include spur; helical, rack, worm, herringbone, bevel, spiral bevel, internal, sprocket, Zerol (R) bevel and Coniflex (R) bevel; also custom gear boxes.

111 CUSTOM PLATE FABRICATION

Continental Boiler & Sheet Iron Works—Bulletin on Total Fabrication describes personnel, equipment, facilities, qualification, and products for custom steel, alloy, and pure metal plate fabrication. Gives list of large machine tools available for job work. Illustrates the meaning and make-up of Total Fabrication.

112 HYDRAULIC MULTIPRESS

Denison Engrg. Div., American Brake Shoe Co.—Bulletin 324 describes the firms' new line of bench type hydraulic presses with capacities of from 1 to 12 tons. Data on special features and dimensions are given as well as available accessories and production advantages.

113 STEAM GENERATOR

Ames Iron Wks., Inc.—Bulletin AA-3 describes advantages of a newly designed low pressure air atomizing burner and new gas ring burner. The Model AA incorporates a 3-pass concentric tube design, single one-piece baffle, and one-piece flue covers.

114 THERMOSTATS

Norwalk Thermostat Co.—Leaflets describe the line of bimetal thermostats. Different types are illustrated and described, including Types A,B, AP, ADP, and other types.

115 LIQUID LEVEL CONTROLS

Fulton Sylphon Div., Robertshaw-Fulton Controls Co.—A 12-page brochure, SF-765, describes float-actuated liquid level controls. A stationary ceramic magnet surrounds sealing tube, inside which magnetic shunt follows changing liquid level. High load electrical snap switches are used. Pneumatic types are available. As many as eight circuits are possible in a choice of housing and mounting types.

Select desired catalogs by number. Requests limited to 25 catalogs.

YOUR
New Catalogs GUIDE
LATEST INDUSTRIAL LITERATURE

116 HYDRONIC PUMPS
Taco Heaters, Inc.—A 16-page catalog, No. 300-4, describes a new line of heating and air conditioning pumps in sizes from $1\frac{1}{4}$ in. through 6 in. and motors from $\frac{3}{4}$ hp through 40 hp. Performance curves are given, as well as a method for selection which provides a pump with nonoverloading characteristics.

117 HYDRAULIC CYLINDER
Tomkins-Johnson Co.—Bulletin SH-6-60 describes T-J high-pressure hydraulic square-head cylinder. Drawings and mounting dimensions are given for the different styles available. A table of maximum allowable push strokes is included.

118 MECHANICAL SYSTEMS
United Shoe Machinery Corp.—An 18-page illustrated brochure describes the operating principles, design configurations, and performance capabilities of the new class of mechanical systems that is being used to transmit, convert, or change motion in the normal manner or through a hermetic seal. Provides advantages not possible with conventional gearing methods.

119 BALL VALVES
W-K-M Div. ACF Industries, Inc.—Bulletin describes Con-O-Sphere ball valves with sealing capsule which is said to give maximum sealing ability plus on flow seal adjustment. Consists of only seven parts. Available in wide range of materials and sizes, from $\frac{1}{8}$ in. to 2 in. vacuum to 1440 psi WOG, and adaptable to a wide range of applications.

120 HIGH PRESSURE AIR AND GAS COMPRESSORS
Norwalk Co.—Catalog 1961 describes the integrated facilities in engineering, production, and testing of custom-production Norwalk compressors from single stage to six stages, from 0 to 42,000 psi pressures for a full range of gases and air.

121 INDUSTRIAL EQUIPMENT
Allis-Chalmers Mfg. Co.—Booklet 25B6057A makes reference from A to Z to literature available on the wide variety of products produced by the company. Capital goods equipment for almost every industry, in addition to construction and agricultural equipment, is covered, ranging from absorption machinery to zeolite softeners.

122 PRESSURE GAGES
American Chain & Cable Co., Helicoid Gage Div.—The 24-page Helicoid gage catalog describes the Helicoid gage as guaranteed accurate to within $\frac{1}{2}$ of 1 per cent of the total dial graduation over the upper 95 per cent of the 270-deg dial arc. Cutaway photographs and line drawings show the complete line of Helicoid gages.

123 RUBBER SEATED GATE VALVES
DeZurik Corp.—An eight-page bulletin, No. 302, describes rubber seated gate valves, lists materials, dimensions, and actuators, and outlines applications.

124 LAMINATED PLASTICS
Continental-Diamond Fibre Corp.—Catalog G-61 describes materials for electrical and mechanical applications, including laminated plastics, vulcanized fibre, printed circuit boards, molded plastics, flexible tapes, and mica products. Brief technical data, suggested applications, and performance specifications are given.

125 FIRE PUMP CONTROLS
Cutler-Hammer, Inc.—A new line of fire pump controllers, approved by Underwriters' and Factory Mutual, is described in an eight-page booklet, which includes a list of considerations that must be examined before selecting proper fire pump protective equipment.

126 CAST-IRON ECONOMIZERS
Green Fuel Economizer Co.—An eight-page bulletin describes both conventional and low-temperature applications of cast-iron economizers for new or replacement use. The corrosion resistance, ease of cleaning, and reduced draft loss of this heat transfer equipment is covered in detail.

127 LATHE CHUCKS, MANUALLY OPERATED
Cushman Chuck Co.—Catalog No. 67-1959, with companion price list, contains listings and detailed engineering data on manually operated chucks for both older and new standard spindle noses.

128 AIR HANDLING UNITS
Dunham-Bush, Inc.—Catalog 6011C lists 26 compact models for cooling, heating, and humidity control with overlapping range of air deliveries from 1000 to 38,400 cfm. Coil information and selection tables, dimensions, engineering section, climatic conditions, psychrometric chart, and specifications are included.

129 SWIVEL AND ROTARY JOINTS
Sealol, Inc.—A six-page brochure describing swivel and rotary joints used in industrial applications. Typical applications, specifications, envelope dimensions, and torque curves are included.

130 OIL AND GREASE
Shell Oil Co.—Technical bulletins cover Darina grease, a multi-purpose microgel grease, and Dromus Oil E, a lubricant for high-speed metal machining operations.

131 FILTERS
Air-Maze Corp. Div. Rockwell-Standard—General catalog describes entire line of air filters and liquid filters, including oil bath air filters for engines, compressors, blowers, heating and ventilating filters and mist eliminators, all metal, cleanable liquid strainers offering down to 10μ filtration, intake silencers, exhaust spark arresters.

132 TIMERS, COUNTERS
Eagle Signal Co., Div. of Gamewell Co.—Bulletin 11 illustrates and describes single cycle reset timers, manual timers, time delay relays, repeat cycle timers, preset counters, step switches, and hermetically sealed timers designed to military specifications.

133 WATER COLUMNS, GAGES
Ernst Water Column & Gage Co.—Bulletin 5-2-60 illustrates and gives specifications of bronze gages, flow indicators, water columns, steel gages and valves, gage glasses and gaskets.

134 LIQUID LEVEL TRANSDUCER
Magnetrol, Inc.—Data sheet 91-91 describes and illustrates a precision level instrument that converts measured liquid level directly to an electrical resistance. A friction-free magnetic coupling is used between the level sensing displacer-float and potentiometer winding inside the instrument case. Resistance change is given.

135 LIQUID LEVEL, FLOW CONTROL
McDonnell & Miller, Inc.—A 24-page booklet provides engineering information, schematic drawings on how to provide operating and safety controls for a variety of jobs involving liquid level and liquid flow.

136 LIQUID HEATERS
Penberthy Mfg. Co.—Bulletin 954 contains specification, capacity, pressure, application, and ordering information on "Inline" liquid heaters, designed for direct connection to liquid and steam lines for applications where hot liquid under pressure is required.

137 WASTE INCINERATION EQUIPMENT
Thermal Research & Engineering Corp.—Equipment for the incineration and/or concentration of various industrial waste materials is described in Bulletin 119. This bulletin shows typical installations for gaseous wastes, liquid wastes, and systems where both liquid and gaseous wastes exist. Catalytic type incinerators are also described.

138 AIR COMPRESSORS
Gardner-Denver Co.—A four-page bulletin, LA-1, describes single-stage, vertical water-cooled air compressors. Two-stage machines also available for pressures to 1000 psig. Complete specification data.

YOUR

New Catalogs GUIDE

139 VIBRATION TEST SYSTEMS

MB Electronics Div. of Textron Electronics, Inc.—Bulletin 436 describes the system performance specifications of the most popular MB Electronics vibration test systems. Specifications of individual components are given as well as the system specifications.

140 SURFACE CONDENSERS

Southwestern Engrg. Co.—Bulletin describes and illustrates Delta Vee surface condensers for the power and process industries and gives operating features and construction details.

141 SHAFT SEALS

Syntron Co.—First bulletin gives data on specifications of mechanical shaft seals for rotating pumps, turbines, compressors, engines and mixers. The second covers roll neck seals for back-up rolls in strip mills, tempering mills and other rolling mills, also internal seal parts and fluid couplings. The third covers marine shaft seals including cartridge split cartridge and split face type.

142 VALVES

Wm. Powell Co.—A 24-page booklet describes bronze, iron, steel, special metal, and alloy valves for handling water, oil, gas, air, steam, and corrosive fluids. It lists materials and gives the type, pressure, temperature ratings, sizes.

143 DRAWING PENCILS

Eberhard Faber Pen & Pencil Co. Inc.—New Microtomic circular and two-page, full-color insert sheet illustrates and describes line of drawing pencils and draftmen's erasers.

144 AUDITORIUM AIR CONDITIONERS

John J. Nesbitt, Inc.—Catalog 22 illustrates and describes AudiCon air conditioner, designed especially for school auditoriums and other large assembly areas where quietness is important. Unit features silencer discharge plenum, plus return air bypass control.

145 STRAIGHTLINE SLUDGE COLLECTORS

Link-Belt Co.—New 28-page Book 2746, describes a line of sludge collectors for rectangular settling tanks. New data enables selection of the proper size tank for both the Type "H" and Type "L" sludge collectors. New mechanical details and arrangement drawings of various designs for both collectors are illustrated and described. The "Ten States Standards for Sewage Works" specifications for sedimentation tanks are reprinted in their entirety.

146 DRYERS

Link-Belt Co.—Fluid-Flo dryers and how they work are described in six-page Folder 2909, which illustrates how this unit can be applied in drying, cooling, roasting, and other processes, with minimum product loss or degradation. A full-page drawing of the Fluid-Flo dryer in an engineered installation shows how granular solids are processed through the system. Laboratory photos illustrate "fluidized" granular solids and the degree of turbulence in incipient, dense and dilute fluidization.

147 METAL CONSTRUCTION

Pittsburgh-Des Moines Steel Co.—A new 44-page brochure describes the overall activities of the company. Special sections are devoted to types of storage tanks and vessels; water purification and filtration; bridges, grandstands, etc., wind tunnels and space age facilities.

148 WATER CLARIFIER

Permutit Co., Div. of Pfaudler Permutit, Inc.—Bulletin 4836 describes Permutit Type M precipitator for the reduction of turbidity, color, suspended matter, iron, and manganese in water. Contains information on design, operation, construction, and specifications.

149 STORAGE RACK SYSTEMS

Bernard Gloeckler North East Co.—An eight-page bulletin gives upright data and stringer data for "Ridg-U-rak" storage systems designed to meet fixed or variable loading requirements. Also includes information on accessories.

YOUR

New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

150 PACKAGED BOILERS

Boiler Div., Ray Burner Co.—Catalogs give description, specifications, and capacities for Ray automatic packaged boilers. HUSKY, FD series and Series E give size ranges from 10 to 600 hp. Units are for operation on all grades of fuel oil, natural or manufactured gas, or combination gas-oil. Tables and other technical data included.

151 AIR DRYER

Hankison Corp.—Detailed information about Series-E air dryer is provided in Bulletin No. 9300. The illustrated bulletin shows how the unit operates, and includes specifications, dew point chart, and installation procedure. The noncycling air dryer has a rated capacity of 10 scfm, and was especially designed for air conditioning applications. It protects pneumatic thermostatic controls against damaging moisture.

152 MATERIALS HANDLING

Syntron Co.—A condensed catalog, No. 616 contains 68 pages of technical data, brief description and photographs of bin vibrators, vibratory feeders, vibratory conveyors, power tools, shaft seals, selenium rectifiers, vibrating parts feeders, and other equipment.

153 RUBBER EXPANSION JOINTS

Raybestos-Manhattan, Inc., Manhattan Rubber Div.—Bulletin M685 describes a line of rubber expansion joints. Advantages and construction features are explained. Recommendations and a table of dimensions are provided.

154 STEEL WIRE

American Chain & Cable Co., Page Steel & Wire Div.—A 16-page catalog, DH-1226, on Page shaped wire includes specification tables, range of sizes, physical properties of steel wire, table of standard wire gages, hardness conversion tables, with illustrations showing how to calculate areas of typical common shapes of wires. Size range includes cross-sectional area up to and including No. 3 BWG; flats and rectangles in widths up to $^3/_8$ in., the ratio of width of thickness not exceeding 6 to 1.

155 PIPELINE PUMPING

Dravo Corp.—Bulletin 1704 illustrates a part of the firm's record of engineering construction of pipeline pumping and compressor stations for the transmission and storage of gas and petroleum products.

156 WORM GEAR JACKS

Duff-Norton Co.—Eight-page bulletin, No. AD-66, describes how two or more jacks can be tied together in a jacking arrangement by means of couplings, shafting, and mitre gears boxes. All jacks will raise and lower in unison and arrangements can be motor driven. Jack capacities range from two to one hundred tons. Specifications and dimensions drawings are included.

157 AIR-HYDRAULIC ACTUATOR

Electro-Mechano Co.—Bulletin describes hydraulic controlled air cylinder used for actuating many mechanical movements. The unit has a unique built-in valve arrangement which allows two different traverse rates throughout stroke. Cams can be set to determine points of rate change.

158 DRAIN OR SAMPLING VALVE

Jerguson Gage & Valve Co.—New Data Unit No. 400 describes the features, sizes, and construction details of special valves built to meet high temperature or corrosive conditions. Design is said to allow the valve stem to work freely at all times and to prevent possible freezing.

159 TAPE INSTRUMENTATION

Instrument Div., Lear, Inc.—A six-page brochure contains detailed information on the Lear concept of moving tape displays for air and space craft. Includes illustrations of the wide range of tape indicators currently in production, cutaway drawings, component details, and application information.

160 PROPELLER, MIXED FLOW PUMPS

Layne & Bowler, Inc.—Bulletin 350 includes propeller and mixed flow pumps with cut-away application photos and performance charts.

161 PUNCHES AND DIES

T. H. Lewthwaite Machine Co.—A 28-page set of catalog sheets lists, illustrates, and cross-references the styles of punches and dies carried in stock. Charts and instructions are given for figuring correct clearance allowances between punches and dies for work being done. Illustrations and specifications of hand operated punches, cutters, and benders are included in the set.

162 AUTOMATIC LIQUID LEVEL GAGES

Liquidometer Corp.—Bulletin 463A describes 100 per cent automatic remote reading tank gages. Information on direct reading gages at tank and hydrostatic type remote reading gages.

163 VIBRATION AND NOISE CONTROL

Lord Mfg. Co.—Bulletin No. 905 lists products designed to reduce vibration, shock, and noise. Different types of mountings, joints, panels, structural sections, mounting systems, and suspensions are covered.

164 TIME ORGANIZER

Kano Laboratories—Literature describes a time organizer system in which items are listed on numbered lines and checked out as completed. The system includes a three-year calendar, annual and monthly check charts.

165 BURNISHING TOOLS

Gustav Wiedeke Co.—Bulletin includes tool specifications for sizes from .312 in. through 8 in. diameter automatic roller type burnishing tools. Modified standard designs for working flats, angles, and tapers are also available. Information on part preparation and operating instructions are included.

166 PUMPS & SYSTEM COMPONENTS

Oilgear Co.—A line of electrohydraulic servo system components is introduced in Bulletin 47740. How pumps and components work, what functions they perform, and where they are applied are described in detail. The introduction explains and illustrates how electrohydraulic servo controlled pumps function. Other pages describe in detail the individual components necessary for a complete system, including specifications and dimensional data. Space is also devoted to typical open and closed loop control system description and explanation.

167 VIBRATION INDUCERS

Martin Engrg. Co.—A 38-page catalog gives engineering data, specifications, and price list on the Vibrolator line of vibration inducers, listing 52 sizes and types from the BD-10 ($4^1/_2$ oz) to the 3000 lb impact CCVP series hopper car shaker (72 lb.). Units are available in pneumatic, electric, gasoline, hydraulic, and steam.

168 FRICTION MATERIALS

Johns-Manville—A 24-page engineering and design data book, FM-57A, gives descriptions, design data, recommendations, characteristics, and a selection chart of industrial friction materials including asbestos brake blocks, linings, and clutch facings. Also discusses specialty products (bearings, bushings, small friction elements), and bonding, riveting, and key-locking methods of attaching friction materials.

A world of facts at your finger tips. Use coupon on page 140 for *free* catalogs you need. (Sorry, no catalog distribution can be made by us to students.)

Need more engineering information on products featured in this issue?

USE THE POSTAGE-FREE CARDS . . .

If you would enjoy receiving additional engineering information on any of the products

advertised in this issue

. . . . .circle the numbers given on advertisements on one of the cards below. . . . . . .fill in your name and mail to us. Your requests will be promptly forwarded. All information will be directed to you.

(Note: Students please write direct to manufacturer.)

MECHANICAL ENGINEERING—NOVEMBER 1961—**Products Advertised**

1	11	30	69	90	123	146	172
2	12	34	70	97	125	150	174
3	13	35	73	99	126	155	178
4	14	36	77	102	127	159	179
5	15	38	78	106	132	162	180
6	17	40	79	108	135	163	181
7	19	51	80	111	136	165	182
8	24	54	83	112	137	167	183
9	26	57	85	117	141	168	184
10	29	62	87	119	142	170	

PLEASE SEND me more complete engineering information on the products advertised in the Readers' Service Card numbers circled above.

NAME. . . . .

TITLE. . . . .

COMPANY. . . . .

ADDRESS. . . . .

CITY and STATE. . . . .

Not good after January 31, 1962

MECHANICAL ENGINEERING—NOVEMBER 1961—**Products Advertised**

1	11	30	69	90	123	146	172
2	12	34	70	97	125	150	174
3	13	35	73	99	126	155	178
4	14	36	77	102	127	159	179
5	15	38	78	106	132	162	180
6	17	40	79	108	135	163	181
7	19	51	80	111	136	165	182
8	24	54	83	112	137	167	183
9	26	57	85	117	141	168	184
10	29	62	87	119	142	170	

PLEASE SEND me more complete engineering information on the products advertised in the Readers' Service Card numbers circled above.

NAME. . . . .

TITLE. . . . .

COMPANY. . . . .

ADDRESS. . . . .

CITY and STATE. . . . .

Not good after January 31, 1962

Need more engineering information on products featured in this issue?

USE THE POSTAGE-FREE CARDS . . .

If you would enjoy receiving additional engineering information on any of the products

advertised in this issue

. . . . circle the numbers given on advertisements on one of the cards below . . . . fill in your name and mail to us. Your requests will be promptly forwarded. All information will be directed to you.

(Note: Students please write direct to manufacturer.)

FIRST CLASS
PERMIT No. 158
St. Joseph, Mich.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

MECHANICAL ENGINEERING

215 Wayne St.

St. Joseph, Mich.

Readers' Service Dept.

MAIL THIS CARD

after circling the numbers and filling in your complete address.
NO POSTAGE REQUIRED

FIRST CLASS
PERMIT No. 158
St. Joseph, Mich.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

MECHANICAL ENGINEERING

215 Wayne St.

St. Joseph, Mich.

Readers' Service Dept.

MAIL THIS CARD

after circling the numbers and filling in your complete address.
NO POSTAGE REQUIRED

YOUR

New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

169 VALVE OPERATORS AND CONTROLS

Ledeen, Inc.—Bulletin 3050 covers company's new line of pneumatically or hydraulically operated valve operators and controls for plug valves, ball valves, and other rotary valves. Fifty-nine actuator models cover torque ranges from 40 in-lb to 4,000,000 in-lb. Selection information, torque ratings, dimensions, and accessory information are given.

170 ALLOY STEEL

LaSalle Steel Co.—Two-page technical Bulletin No. 22 gives detailed information on LaSalle "e.t.d." 150 Alloy Steel Bars. Made by the patented elevated temperature drawing process, "e.t.d." 150 has a guaranteed 150,000 psi tensile strength, requires no heat treating, and is said to machine better than heat treated in-the-bar alloy steels.

171 STEEL PIPE

Youngstown Sheet & Tube Co.—Bulletin lists specifications for continuous weld, seamless Standard steel pipe for transmission of air, gas, steam, water, oil, and other fluids in residential, commercial, and industrial installations.

172 COLD ROLL FORMING

Yoder Co.—An 88-page reference manual on cold roll forming covers operating speeds, tooling, personnel training and operating techniques, surface finish, uniformity, forming of pre-coated stock, selecting proper equipment.

173 SLIDING GATE CONTROL VALVES

OPW-Jordan Corp.—Eight-page Catalog J170-1 describes sliding gate control valves in sizes from 1/4 to 6 in. Benefits of sliding gate construction are explained. Illustrated catalog includes features, cutaways, applications, sizing, controllers, and positioners.

174 THREAD INSERTS

Heli-Coil Corp.—Catalog on standard line of screw thread inserts designed for protection and repair of tapped threads in all materials is contained in Bulletin 652-A. Covered are design information, drilling and tapping recommendations, and specifications for various classes of fit. Also available is Bulletin 738 which provides similar details on new screw-lock insert which eliminates the need for lock washers, lock nuts.

175 VALVE CONVERSION UNIT

C. H. Wheeler Mfg. Co.—A new automatic valve actuating conversion unit is described in Catalog V-200. It is called Valvmatic and converts hand-operated valves to motor operation without removing the valve from line or disturbing piping. It is actuated electrically, and will open and close windows and operate valves.

176 PLASTIC PIPE FITTINGS

Grinnell Co.—A 16-page catalog on corrosion resistant pipe fittings, flanges, valves and pipe in normal impact grade and high impact grade, rigid, unplasticized polyvinyl chloride shows characteristics, advantages and limitations. Listed are operating pressures, temperatures, applications, price comparisons, etc.

177 DRAFT GAGES

Ellison Draft Gage Co.—Inclined tube draft gages, vertical tube draft gages, velocity gages, U-tube gages, and pitot tubes are covered in a 16-page bulletin, 109 E. Text covers also accessories and fittings.

178 POLY-V DRIVE

Raybestos-Manhattan, Inc., Manhattan Rubber Div.—Bulletin M141 illustrates and describes the firm's Poly-V drive, a power transmission system that uses only two cross sections instead of five standard V-belts. The unit is said to eliminate problems of matching belts because it is a single unit across the full width of sheave.

179 BELLOWS

Flexonics—Eight-page design guide covers application and selection of metal bellows for valve stem seals, steam traps, shaft couplings, shaft seals, and temperature or pressure sensing devices.

180 REFRACTORIES

Carborundum Co.—Bi-monthly bulletins about refractories, their properties, uses and recent developments, are available. Subjects covered include muffled constructions, brickwork construction, research and development, a new silicon carbide refractory, wear resistance refractories, hot strength, heat resistance of refractories, thermal-shock resistance, chemical resistance, and stability.

181 INDUSTRIAL COOLING FANS

Koppers Company, Inc., Metal Products Div.—A 4-page folder illustrates and describes new, all-metal, "Precision-Engineered" Aeromaster fans for cooling towers and radiator-type coolers. Design features are discussed.

182 CENTRIFUGAL PUMPS

Nagle Pumps, Inc.—A four page folder, Selector, gives briefing on the company's line of pumps for abusive applications. Horizontal shaft and vertical shaft pumps are shown, the latter designed to reduce stuffing box and bearing troubles.

183 WATER CLARIFIER AND SOFTENER

Graver Water Conditioning Co.—Bulletin WC-103C describes the Reactivator, a high flow rate water treating unit for clarification and softening by coagulation by the cold lime-soda ash process. The unit features short retention time made possible by solids contact through positive sludge recirculation and deep clear water zone.

184 TWO-DRUM PACKAGE BOILER

Erie City Iron Works—A 16-page catalog with cutaway views shows, step by step, the design and construction of the Keystone 2-drum water tube package boiler for oil or gas firing. The complete boiler unit is in even balance for easy handling to the job sight or for easy removal to another location. Fold-out pages reveal details at a glance. Data are included for capacities from 5000 to 100,000 lb of steam per hour.

185 HUMIDIFICATION EQUIPMENT

Bahnson Co.—Catalog Section 104 details the firm's line of industrial humidification equipment. Information and pictures describe and show various types of steam and water humidification equipment. The different uses, capacity, function, and operation of each type is explained.

186 ANALOG COMPUTING COMPONENTS

George A. Philbrick Researches, Inc.—Brief catalog, four pages, describes typical instruments from operational amplifiers, manifolds, linear and non-linear operators and power supplies, to a fully integrated display system that affords instantaneous and automatic calibration for voltages and time (up to eight variables) on screen of a standard oscilloscope.

187 SEAMLESS WELDING FITTINGS

Babcock & Wilcox Co., Tubular Products Div.—FB 502 A is an eight-page brochure covering carbon, alloy, and stainless steel seamless welding fittings and flanges. It contains charts of standard sizes and schedules according to ASA B36.10 and ASA B36.19. Bulletin illustrates fittings and flanges commonly produced, and lists sizes and types available.

188 COORDINATE MEASURING MACHINE

Sheffield Corp.—Catalog FI-22, four pages, describes the Ferranti Fi-22 Coordinate Measuring Machine for fast, precise measuring of the holes and surfaces of parts in two dimensions with automatic numerical visual readout.

189 BOILER, TANK CONTROL

Commercial Shearing & Stamping Co.—Three catalogs are offered. Catalog P-2 covers products for boiler and tank manufacture; 200-Cl, standard metal shapes available without tool and die charge; 900-P5, stampings, forgings, rotoforms.

190 PRESSURE REDUCING REGULATORS

Strong Div., White Sewing Machine Corp.—Bulletin SM 71 gives applications, operating descriptions, dimensions, and other data on Strong balance valves, pilot operated valves, and direct action valves.

YOUR

New Catalogs GUIDE

191 HYDRAULIC PRESSES

Wabash Metal Products Co.—Catalog 16 gives extensive data on the firm's bench and floor model presses for laboratory, testing, and tryout work. Models with heated platens. Available with manually applied pressure and motorized models from 12 to 100-ton capacity. Shows presses in use, lists many uses and users.

192 DRAFTING MACHINE

Universal Drafting Machine Corp.—Tracmaster, a drafting machine for large size work which features automatic board tilt, is described. The unit has beam-rails that require no initial alignment or subsequent adjustment for straightness. Engine-divided graduations on each rail divide, in effect, the drawing area into a 10-in. grid pattern.

193 PILLOW BLOCK BEARINGS

Triangle Mfg. Co.—A 24-page Catalog SC-61 covers applications, variations, lubrication, and installation of pillow block bearings and mountings. Included are sleeve type, self aligning pillow blocks, single bolt mountings, and flange mountings of several types. Rubber cushioned mountings for noise and vibration suppression are also described.

194 TURBO FURNACE

Riley Stoker Corp.—A 16-page bulletin, No. 5129, describes and illustrates the versatility and advanced operating characteristics obtained in fuel burning and steam generation with turbo furnaces, which cover a complete range of capacities, pressures, temperatures, and fuel application for public utility and industrial installations.

195 CONTROLLED FEEDING

B-I-F Industries Div., New York Air Brake Co.—A bulletin, 4.20-1, describes feeding, weighing, blending, and proportioning equipment for the controlled feeding of liquids and solids in process industries. Process control involving either a single unit or a fully integrated system can handle both simple and hard-to-handle materials, from soda ash and industrial alcohols to liquid latex, carbon black, and rocket propellants.

196 VARIABLE SPEED DRIVE

Cleveland Worm & Gear Div., Eaton Mfg. Co.—Bulletin K-275 describes the motorized Cleveland Speed Variator, available in various baseplate assemblies and equipped with a manual handwheel or several types of remote control. The unit consists of a mechanical variable speed drive integrated with pancake type motor.

197 PNEUMATIC & HYDRAULIC PACKINGS

Chicago-Allis Mfg. Corp.—A 16-page catalog illustrates and describes the complete line of the company's pneumatic and hydraulic packings. It contains comprehensive information on the various materials used, conditions of operation, typical design applications, specifications, and data charts on packings in standard sizes, and serves as a design handbook and guide.

198 GAGING CARTRIDGES

Sheffield Corp.—A 32-page booklet gives application data on the use of Plunjets air gaging cartridges with instruments. Included are types, sizes, amplification tolerance, and range of the units. Engineering and technical data for applying them to single and multiple dimension inspection and machine control is included.

199 HEAT EXCHANGERS

Griscom-Russell Co.—A 24-page catalog describes a line of "Pre-Engineered" shell and tube heat exchangers using standardized components, available in 3 standard tube lengths, 25 shell diameters; 2, 4 or 6 passes tubeside; and 150, 300, and 450 lb tubeside and shellside pressures. Contains complete engineering data, including design and construction details, setting plans, stacking dimensions, tube counts, and surface areas.

200 NICKEL-CONTAINING CASTING ALLOYS

International Nickel Co.—A 28-page "quick guide" to all nickel-containing casting alloys gives chemical compositions, important properties, and a capsule review of each alloy to help reader pinpoint the best alloy for his application. Includes cast low alloy steels, stainless steels, ductile iron, alloyed cast irons, nonferrous cast alloys, cast high-nickel alloys, and nickel-alloyed aluminum castings.

201 CHEMICAL MOTORS & DRIVES

Louis Allis Co.—A four-page application bulletin describes motors and drives used in the chemical processing industries. Featured are application photographs of gearmotors, adjustable speed drives, and explosion-proof, nonventilated, drip-proof, and wound rotor motors. Descriptive information on all equipment is outlined in the bulletin.

202 HEAT TREATMENT

Link-Belt Co.—Four-page Folder 2922, describes Spin/Hard heat treatment of sprockets, gears, traction wheels, rollers, and other products requiring hardened areas for high wear resistance. Spin/Hard heat treatment produces a minimum hardness of 55 Rockwell C, $^1/_8$ in. to $^1/_2$ in. deep, on iron and steel castings and fabricated components from 8 in. to 42 in. diameter. The treatment hardens wearing areas only and allows remainder of component to retain its machinability.

203 JOURNAL BUSHINGS

Southwest Products Co.—A four-page bulletin, No. 1060, covers "Dyflon" plastic alloy lined, self-lubricating journal bushings which are said to provide lower coefficient of friction and withstand chemical solvents. Plain and flanged types, with bore sizes to 3.0000 in.

204 VALVES, CONTROLS

Hays Mfg. Co.—A packet of data sheets covers the firm's lines of solenoid valves, controls, strainers and automatic interlocks. Specifications, dimensions and flow charts are given.

205 ECCENTRIC PLUG VALVE

W-K-M Div. of ACF Industries, Inc.—W-K-M's new eccentric type plug valves are described in Bulletin AE 1059. They feature elastomer coated plug for tight sealing, and are nonlubricated, wrench or gear operated with maximum flow, quarter-turn open or close. Sizes $^1/_2$ in. through 12 in., 150 lb cwp.

206 MATERIALS HANDLING

Webster Mfg., Inc.—Brochure FL-661 describes the firm's materials handling systems, components, products, and services as specialists in bulk handling equipment.

207 COPPER, COPPER ALLOYS

Anaconda American Brass Co.—Publication B-36, a 30-page booklet on "Corrosion Resistance of Copper and Copper Alloys," covers theory of corrosion, types of corrosive attack, corrosive rating charts, industrial uses of copper alloys, mechanical and physical properties of copper alloys. The booklet is intended to help in the selection of copper alloys for specific uses.

208 STEREO-ZOOM-MICROSCOPES

Bausch & Lomb—A catalog discusses principles and equipment used in connection with stereomicroscopy. A guide to the selection of stereomicroscopes and accessories is included. Catalog D-15.

209 STORED ENERGY SWITCH GEAR

I-T-E Circuit Breaker Co.—A 40-page bulletin, No. 2800-2B, details information on company's new line of 4.16- and 13.8-kv stored-energy switchgear. Data cover design and operating features, panel arrangements, and dimensions. It also includes application information, a simplified specification guide, photographs, drawings, and sketches.

210 VACUUM JACKETED PIPING

Uni-Flex Mfg. & Engineering, Inc.—Four-page brochure on multi-jacketed piping provides the engineer with a sample specification for cryogenic piping and a table of conversions between Kelvin, Centigrade, Fahrenheit, and Rankine scales.

211 PUMPS

Jabsco Pump Co.—Condensed industrial catalog sheet describes self-priming, flexible impeller pumps for industrial, chemical, plumbing, and farm applications. Includes new "Pureflo" sanitary pumps for dairy, food, and beverage processing industries. An expanded "Chemical Resistance Table" offers results of laboratory tests conducted with various chemicals, foodstuffs, and oils, and their effects on materials used in the construction of Jabsco pumps.

YOUR

New Catalogs GUIDE

212 BELTED VENTILATING SETS

Barry Blower Co.—Bulletin 410 describes a complete line of belted ventilating sets of the non-overloading type, in sizes ranging from 12-in. to 36-in. wheel diameter and through a full capacity range for both supply and exhausts. Available with numerous accessories for air conditioning application.

213 WELL WATER SYSTEMS

Layne & Bowler, Inc.—Bulletin No. 10 gives general facts and information well water systems, pumps, drilling and allied services and equipment. The bulletin covers water well systems, oil and water lubricated vertical turbine pumps, special water well drilling, service work, shutter screens, irrigation wells and pumps, water and well treatment for rehabilitating water sources and other phases of water development for industry and municipalities.

214 AIR COMPRESSORS

Lincoln Engrg. Co., Div. of McNeill Machine & Engrg. Co.—A 16-page catalog, No. 20, covers a line of air compressors for automotive, industrial, and contractor applications. Included is data on more than 200 models, both gasoline and electric driven, featuring automatic start-and-stop and constant-running units, plus illustrations and descriptions of compressors available with either horizontal or vertical tanks.

215 NUCLEAR FORGINGS

U. S. Steel Corp.—Six-page folder describes and pictures such forgings as rings, disks, closure heads, and vessel flanges, available for use in nuclear reactor construction.

216 COUNTING DEVICES

Veeder-Root, Inc.—Modern mechanical electrical, and electronic counters for all industrial and special counting requirements are briefly described in a four-page condensed general catalog. Also contains information on applications and how-to-order.

217 ARC WELDING EQUIPMENT

Lincoln Electric Co.—A catalog of Lincoln manual arc welding equipment includes a complete description of electrodes for mild alloy and stainless steel welding and for hardsurfacing and nonferrous metal welding. It describes also motor generator, engine driven, transformer and rectifier welding machines and accessories.

218 WIRE ROPE AND SLINGS

Union Wire Rope, Subs. of Armco Steel Corp.—"Handbook of Tuffy Tips" gives tips on abuses, correct handling, and lifting for wire rope and slings.

219 ROTARY WATER STRAINER

Andale Co.—Bulletin 612 illustrates and describes equipment for continuously straining raw water on the suction or discharge side of pumps. Capacities range from 600 gpm to 30,000 gpm. Strainer element openings are $^1/_8$ in. to $^1/_{32}$ in. Separate backwash circuit has external connections, is continuous or is automatically controlled.

220 GASKETS METAL RASCHIG RINGS

Metallo Gasket Co.—Bulletin No. 57 describes metal and metal combined with soft packing for use on high and low pressure service, metal tower packing made as Raschig and Lessig rings. Also washers, shims, and metal asbestos valve disks.

221 VINYL, ABS AND POLYURETHANE

B. F. Goodrich Chemical Co.—A 16-page booklet describes properties and illustrates applications of Geon vinyls, Abson ABS materials and Estane polyurethane materials for industrial and consumer uses in extrusions, film and sheeting, molded products, expanded vinyls, coatings, and rigid materials.

222 SPREADER STOKERS

Erie City Iron Wks.—Catalog SB62 describes dumping grate spreader and the Travagrate (continuous ash discharge) spreader stokers. Coal feed and control for both types are illustrated. The hydraulic Travagrate drive unit is shown in phantom view. Typical applications are included.

223 BALL-BEARING SWIVEL JOINTS

Chiksan Co.—General Catalog G-5 covers the company's complete line of ball-bearing swivel joints, loading arms and flexible assemblies. Included are information on how to use swivel joints, applications, and dimensional and operating data.

224 TUBE EXPANDERS

Gustav Wiedeke Co.—Catalog 81B contains specifications, tube sizes, and ordering information on the firm's comprehensive line of tube expanders and cutters. Also shown are tube rolling motors and torque controls and miscellaneous tube tools and accessories.

225 VARIABLE SPEED DRIVES

Browning Mfg. Co.—Catalog VPS-101-A covers a complete line of variable speed drives from fractional hp to 100 hp. The catalog contains specifications of the various types of variable pitch sheaves, companion sheaves, and motor bases, all of which are available from stock.

226 SPRING PINS

C. E. M. Co.—Catalog lists prices, dimensions, technical information on heavy, medium, and light duty Spirol spring pins in carbon steel, chrome stainless steel, and nickel stainless steel. Typical applications are illustrated.

227 FACTORY ROOFING SHINGLES

Philip Carey Mfg. Co.—A four-page folder, No. 6508, shows application of Fire-Chex asbestos-plastic roofing shingles on factory roofs. Details include explanation of Class A Underwriters Laboratories fire safety rating, Sta seal tabs, 25-year guaranty bond, and available colors. Photographs show installation on saw-tooth and monitor-type roofs.

228 WATER TUBE BOILERS

Henry Vogt Machine Co.—A 24-page bulletin describes Class VF and Class VS 2-drum bent tube boilers. Photos and line drawings illustrate typical units as installed in industry.

229 DRAFTING ROOM EQUIPMENT

Hamilton Mfg. Co.—Catalog ADR-612 lists steel and wood drawing tables and files for drafting room needs. It includes data on Torsion Auto-Shift table, information about the "L" table and shallow drawer unit with tracing lifter, new Hamilton Moducor roll files.

230 AXIAL FLOW PUMPS

Allis-Chalmers Mfg. Co., Hydraulic Div.—Axial flow pumps of adjustable and fixed blade types are described in Bulletin 02B9229. They are applicable for heads ranging from 5 to 55 ft. and have been built in sizes from 11 to 150 in. in diameter with discharges from 3000 to 900,000 gpm. Bulletin includes settings, preliminary sizing data, specifications, application.

231 BIN OUTLET

Bin-Dicator Co.—Catalogue describes two basic types of dry, bulk material level controls. The Roto-Bin-Dicator employs a motorized rotating paddle. All models Underwriters' Laboratory, Inc. listed either general-purpose or explosion-proof. The original Bin-Dicator employs a counter-weighted diaphragm actuated switch. Typical applications and wiring diagrams are included.

Free literature listed here may help you solve a perplexing power problem. Select catalog data carefully by number, then fill in coupon on page 140 and mail promptly.

YOUR New Catalogs GUIDE

232 SPECIALTY STEELS

Crucible Steel Co. of America—Catalog lists descriptions of literature, technical aids and data sheets published by the firm in the field of utilization of specialty steel products.

233 O-RINGS

National Seal Div., Federal-Mogul-Bower Bearings, Inc.—This National O-ring catalog is designed for broadest usefulness in all types of O-ring applications. Includes practical working information about O-ring applications, sizes, groove dimensions, back-up rings, and dust seals, and lists all National O-rings and local National Seal Division offices.

234 CONTROLS, INSTRUMENTS

Fischer & Porter Co.—A 54-page catalog describes the company's products including indicating, recording, controlling, and transmitting instruments for flow, pressure, temperature, density, viscosity, and consistency.

235 VERTICAL FOUR-SLIDE MACHINE

Torrington Mfg. Co.—Bulletin V-80, V-81, V-82, and V-83 detail operating features, specifications for new Verti-Slide all-purpose vertical four-slide machine. Design details and component functions are given for feed mechanism, cam and cam shafts, drive system, and presses. Photos illustrate operation of slides, slide bases, center former, lubrication system, and clutch.

236 ROTARY PUMPS

Viking Pump Co.—Eight-page Catalog 61S includes illustrations and specifications on general purpose and heavy-duty rotary pumps. Capacities range from $1/2$ to 1050 gpm, pressures up to 200 psi on heavy-duty models.

237 BOILERS

Titusville Iron Works Co., Div. Struthers Wells Corp.—Bulletin B-3456 describes Scotch Marine Boiler. Three-Pass design package Fire Tube unit eliminates the need for refractory baffles. The unit attains 80 per cent efficiency and is said to deliver maximum economy and to save space, fuel, and care. It is adapted for gas, oil, and gas-oil combinations.

238 ELECTRONIC CHASSIS LATCH

Hartwell Corp.—A four-page, two-color bulletin gives information on the Gripwell electronic chassis latch. These latches are designed specifically for modular cabinets. The bulletin covers the Hartwell 307 latch, a large $5^1/_4$ in. chassis handle, and the Hartwell 316 latch, a smaller $4^3/_4$ in. handle. This bulletin is accompanied by sales outline drawings, and includes procurement information.

239 CLUTCHES

Mercury Clutch Div., Automatic Steel Products, Inc.—An eight-page folder gives specifications, applications, and special data on two general types of clutches for gasoline engines and electronic motors. Also listed are brakes, chain, and accessories. Factory representatives and central distributors are listed.

240 BRUSHLESS GENERATORS

Kato Engrg. Co.—A 16-page brochure describes applications for brushless alternators. Nonwearing components replace such parts as commutator, slip rings, brush holder assemblies, and brushes, thus reducing maintenance costs. Catalog also includes descriptions and applications of Kato control equipment and power systems.

241 SPIRAL CONVEYOR

Jeffrey Mfg. Co.—Catalog 951, 56 pages, includes engineering data, conveyor layouts, specifying information, specifications, drives, capacity tables, feeders, hangers, troughs. Charts, drawings, photographs support detailed description.

242 TRANSDUCERS

Pace Engineering Co.—Catalog describes a line of magnetic reluctance pressure transducers, including d-c output types with self-contained carrier-demodulator, and provides detailed performance specifications. Typical associated equipment and recording systems are described.

243 SCREW THREAD GAGING

O-Vee Gauge Co.—"Recommended Gaging Practice" is a widely-discussed chapter of the Screw Thread Standard H.28 (1957 edition). These recommendations are based on basic screw thread geometry and experience. A ten-page booklet, ME.61, illustrated by diagrams, shows why the new gaging requirements will improve the inspection of threaded products.

244 REFUSE INCINERATOR WALLS

Bernitz Furnace Appliance Co.—Bulletin B-58 describes silicon carbide air-cooled blocks for incinerator walls. The blocks are designed to improve combustion, insure long furnace wall life, and reduce maintenance and down time.

245 FAN-COOLED SPEED REDUCERS

Cleveland Worm & Gear Div., Eaton Mfg. Co.—Bulletin 415 introduces the complete line of Cleveland's fan-cooled worm gear speed reducers. Included are product features, cost, size, and horsepower comparisons between standard and fan-cooled reducers. Through fan cooling, horsepower ratings as much as 100 per cent greater than those of standard units have been obtained. In addition, the new units have such features as "Flamatic"-hardened worms, centrifugally-cast bronze gears, oversized shafts and bearings, and heavily finned cast iron housings.

246 CENTRIFUGAL COMPRESSORS

Elliott Co.—Bulletin P-11 illustrates and describes line of multistage compressors. Included are selection calculations, performance curves, and Mollier diagrams for various gases. Mollier diagrams feature a new extension of the low temperature range.

247 TRANSMISSION BELT

Manhattan Rubber Div., Raybestos-Manhattan, Inc.—Literature covers the new Poly-V "J" belt, especially designed for high-speed, small-pulley power transmission applications. It will operate over sheaves as small as 0.8 in. pd. Pitch lengths range from 8 to 98 in.

248 EXPANSION COMPENSATORS

Flexonics—Bulletin 222B describes new high-pressure expansion compensators in stainless steel and bronze. Units have been especially designed to replace the previous methods of expansion compensation, such as slip joints, swing joints, pipe loops, or bends; units are available in pressures to 175 psig, temperatures from −60 to 250 F, and $1^1/_4$ in. compression and $1/_4$ in. extension.

249 AUTOMATIC GRAVITY FILTER

Graver Water Conditioning Co.—Bulletin WC-130 presents the Monovalve filter, a fully automatic gravity filter with a single, simple control valve that stores its own backwash water and is said to provide a reliable source of uniformly pure filtered effluent. Available in flexible single or multi-compartment units, the Monovalve wastes no water to initiate backwash, operating automatically on a loss-of-head principle, and requires minimum maintenance and attention.

250 VIBRATING FEEDERS

Syntron Co.—A 48-page catalog covers standard and special model electromagnetic vibrating feeders for hard-to-handle bulk materials. Descriptions, data, and specifications along with installation photos and application diagrams.

Read carefully . . . select wisely, then send coupon on page 140 now for your free catalogs. Requests limited to 25 catalogs. (Sorry, no catalog distribution can be made to students.)

YOUR

New Catalogs GUIDE

251 ALLOY MECHANICAL TUBING

Babcock & Wilcox Co., Tubular Products Div.—Bulletin TB-430 is a primer on the use of alloy steel mechanical tubing. It describes structural, fabrication, and design advantages of tubing and gives tips on obtaining economies in the purchase of alloy steels in tube form.

252 ABUSIVE PUMPS

Nagle Pumps, Inc.—Catalog 5206 describes a line of pumps for abusive applications. Industrial applications are listed, and charts give discharge size, dimensions, and weight. Types of impellers are described, and the booklet is illustrated with photographs and section drawings.

253 LIQUID SUPPLY SYSTEMS

Adsco Div., Yuba Consolidated Industries, Inc.—A six-page folder presents step-by-step fabrication and cleaning process for military and industrial cryogenic systems. Photographs illustrate facilities and techniques which provide surgery room cleanliness approved by military engineers for missile components.

254 LOAD CELL TRANSDUCERS

Electronics & Instrumentation Div., Baldwin-Lima-Hamilton Corp.—Load Cell Bulletin 4355 A describes complete line of BLH load cell transducers, including applications, outline drawings, and a thorough compilation of load cell specifications. All accuracies and capacities of these bonded strain gage transducers are presented clearly with regard to any electronic force measurement application.

255 LUBRICANTS, COMPOUNDS

Shell Oil Co.—A series of folders gives data on properties, testing, applications of a new atomic power lubricating grease, an extreme temperature range lubricant or missile applications, an emulsion-type lubricant for large low-speed diesel engines, compounds and fluids for open gears under extreme pressure loads, and the company's oil-print analysis for field diagnosis of motor oils.

256 RIGID PVC PIPE

B. F. Goodrich Industrial Products Co.—Bulletin 10050 covers properties, chemical resistance, design data, specifications, and installation of Koroseal rigid vinyl piping.

257 BRASS MILL TERMS

Anaconda American Brass Co.—A 24-page illustrated lexicon called "Copper & Copper Alloy Metalexicon" untangles complex terminology applied to brass mill products.

258 MANUAL, SOLENOID VALVES

Barksdale Valves—Catalog 59-60 covers manual, foot-operated, and solenoid valves. Manual and foot-operated valves are 4-ways, shut-off, manipulator, and dual pressure. Solenoid models include 4-way, 3-way, shut-off and diverter valve series.

259 ANTIFRICTION BEARING SCREW

Roton Products Div., The Anderson Co.—A 22-page illustrated brochure describes the basic operating principles of the Rotor bearing screw and typical applications, the planetary drive for speed reduction and mechanical advantage with freewheeling at the end of travel, and the positive drive for accurate linear positioning. Included are engineering drawings of standard Roton assemblies and complete order information and price lists.

260 AIR DIAPHRAGM CYLINDERS

Westinghouse Air Brake Co., Industrial Products Div.—A four-page catalog illustrates and describes diaphragm air cylinders and diaphragm air chambers with effective areas from 9 to 50 sq in. and strokes from 1¼ to 4 in.

261 SYNCRO-RANGE DRIVES

Louis Allis Co.—Bulletin 112 describes the operation of Syncro-Range Select-A-Spede drives. Ranging in size from 5–200 hp, these drives are suited for operation on multi-unit conveyors, textile or paper printing, etc. Referred to as a "packaged system," the Syncro-Range Select-A-Spede drive consists of an adjustable frequency power supply, operating on 3-phase, 60-cycle power input powering a number of Syncro-Spede motors running in exact synchronism over a wide range of speed.

262 BEARING, JOINT SEALANTS

American Sealants Co.—Easier tolerances and improved alignment made possible with new techniques for retaining anti-friction bearings with Loctite sealant are described in a brochure. Also included is information on how to stop breakdowns due to loose nuts and bolts by using the liquid lockwasher and how to seal joints against high fluid pressures without mixing or pot life problems.

263 CONTROL VALVES

Ledeen, Inc.—Bulletin 5000 describes Spanseal valves. Control valves for 1500 psi pneumatic or hydraulic service are manifold mounted and feature interchangeable operating attachments—pilot pressure operated, low and high pressure operated, direct solenoid operated, and manually operated. Line size valves for 1200 psi service have integral actuator which shifts valve with direct low pilot pressure signal.

264 FLEXIBLE COUPLINGS

Poole Foundry & Machine Co.—A 136-page manual illustrates, describes and gives engineering specification and lubrication data on flexible couplings.

265 DRAFTING MATERIALS

Frederick Post Co.—Ten separate catalog sections are each devoted to a particular phase of the engineering and drafting field. Over 6000 illustrated items, outlined in charts, provide a ready-reference to the line of sensitized products, reproduction machines, tracing and drawing media, drawing instruments, slide rules, drafting scales, drafting equipment, furniture, field equipment, and sundry supplies.

266 PACKAGE DEAERATING HEATER

Graver Water Conditioning Co.—Bulletin WC-126 describes LSC deaerating heater, designed in wide choice of sizes for the medium-size steam generating plant. Complete with all accessories and ready to operate, the LSC is said to feature low initial cost, minimum maintenance, guaranteed performance, and low space and headroom requirements.

267 CONVEYOR BELTS

Cambridge Wire Cloth Co.—A 134-page catalog contains flow sheets for a number of industries, a section on selection of alloys and metals, diagrams on layout of conveyors, and engineering data.

268 HYDRAULIC EQUIPMENT

Hydreco Div., New York Air Brake Co.—An eight-page guide to Hydreco hydraulic pumps, fluid motors, and control valves. Charts on performance data together with complete product descriptions and suggested applications are included.

269 STEAM AND WATER SERVICE

The Powers Regulator Co.—Specially prepared for plant use, the manual is designed for personnel whose job function covers operation or installation of steam-water service. Various control systems described and illustrated include: domestic hot water, instantaneous heat exchangers, heat exchangers for cooling, fuel oil heaters, pressure reducing, jacket water cooling, and two-temperature hot water systems.

270 STAINLESS STEEL

Sharon Steel Corp.—A 32-page catalog offers description, chemical composition, strength factors, physical properties and applications for stainless steels, including the 200, 300, and 400 series. Bright annealed and rolled-in surface patterned stainless steels are included.

271 CENTRIFUGAL FAN

Sturtevant Div., Westinghouse Electric Corp.—A 20-page catalog, 1125, describes the Centriline fan, an airfoil centrifugal fan with in-line airflow, said to offer all the advantages of centrifugal fan performance in a space-saving shape which can be installed in less than half the usually required space.

272 HEATER SECTIONS

L. J. Wing Mfg. Co., Div. of Acro-Flow Dynamics, Inc.—Bulletin IFB-61 describes new heater sections for air conditioning preheat, fresh air supply, and process and drying applications. Units feature integral face and by-pass damper system for temperature control without steam modulation, uniform discharge temperatures, no stratification, and constant air resistance across section. Sizes range up to 35,000 cfm.

273 PUMP CONNECTORS

Cobra Metal Hose Div., DK Mfg. Co.—Catalog PC-79 describes flexible metal pump connectors—said to provide flexibility for absorbing vibration, shock, impact expansion, or contraction. Catalog illustrates, describes, and gives specifications, including temperature and pressure of 36 different models in bronze and stainless. Sizes range from 3/4 to 8 in. id and up. Lengths are standard.

274 COPPER ALLOYS

Anaconda American Brass Co.—An enlarged edition of its "Copper & Copper Alloy Specifications Index" lists the most generally used alloys and products of the company, together with the applicable specifications of the eight following agencies ASTM, ASME, AWS, SAE, AMS, Federal Military, and Joint Army-Navy.

275 LOCK WASHERS

Illinois Tool Works, Inc., Shakeproof Div.—"This Washer Locks" is an eight-page book that shows the features of Shakeproof lock washers and contains schematic drawings, charts, and photos showing problem applications. In addition to product descriptions, a number of actual examples of use are illustrated.

276 DIAPHRAGM VALVES

Grinnell Co.—An 8-page catalog describes diaphragm valves offering streamlined fluid passage, flow control, leak-tight closure. Isolation of working parts from fluid stream is said to prevent product contamination and corrosion of operating mechanism. Flexibility of assembly and wide choice of materials for bodies, body linings and diaphragms are described.

277 DIESEL, DUAFUEL ENGINES

Nordberg Mfg. Co.—Series 29, two-cycle diese and Duafuel engines for stationary and marine service are described in a 16-page bulletin, No. 235A. With 29-in. bore and 40-in. stroke these engines are claimed to be the most powerful single action, two-cycle engines built in America.

278 MEDIUM DATA PROCESSING SYSTEMS

Minneapolis-Honeywell Regulator Co.—Brochure describes specifications of Honeywell 400, a small magnetic tape data processing system. High-speed peripheral equipment plus efficient central processor are said to insure low unit costs for processing and maintaining files.

279 LUBRICATING SYSTEMS

Farval Div., Eaton Mfg. Co.—Bulletin 27 discusses the complete line of the firm's centralized lubricating systems. The eight-page bulletin introduces Farval-Tanway, single line system, as well as standard Dualine systems, spray systems for lubricating slide surfaces and wide-faced gearing, Multival for serving a limited number of bearings, and Lubrival for lubricating automatic and semiautomatic machinery having return oil arrangements.

280 AIR CONDITIONERS

Marlo Coil Co.—Multi-zone central station units for heating, cooling, dehumidifying, humidifying, and filtering are described in Bulletin 34. The units supply heated or cooled air simultaneously and independently to several zones. The bulletin includes construction and operation data, charts and graphs on coil ratings, K factors, and other technical information.

281 VALVES

J. H. H. Voss Co.—Bulletin 53-G covers valves for air, gas, or ammonia compressors. The valves are machined from solid stock; plates are machined and ground; valves and plates are of heat treated alloy or stainless steel, custom designed for individual characteristics of compressor.

282 DOUBLE SUCTION PUMPS

Warren Pumps, Inc.—Bulletin 251 covers Type DMB and DB ball bearing horizontal split, case, double suction centrifugal pumps for general water services. The bulletin includes specifications, sectional view, selection table, and outline dimensions.

283 GUIDE TO HIGHER PRODUCTIVITY

Materials Handling Div., Yale & Towne Mfg. Co.—A 25-page booklet gives seven easy-to-apply ratios that will uncover handling weaknesses in various phases of the production operation. The booklet contains practical examples of the calculations necessary to work out the ratios.

284 PACKINGS

Linear Inc.—Eight-page folder contains tables of standard Vee-Dam fabric reinforced V-ring sizes as well as dimensional data for installation. Notes contain general recommendations for design, installation and gland adjustment. A description of 14 standard material recommendations for a wide variety of fluids, pressures, and temperature ranges is also included.

285 HEATING AND COOLING UNIT

Mammoth Industries, Inc.—YR series enclosed weatherproofed "Compact-Aire" roof top heating cooling unit for outdoor installation is described in Bulletin YR-460. Units are available in four sizes with Btu outputs, gas or oil, from 150,000 to 500,000. Coil space, blower capacities can handle any standard cooling equipment from 3 to 20 tons.

286 RELIEF VALVES

Crosby Valve & Gage Co.—A 100-page catalog, 301, describes complete line of safety-relief and general service relief valves. Included are valve styles, sizes, pressure-temperature limits, materials specifications, performance data, and capacity information. A special materials valves section contains a guide to corrosion resistant properties of materials and excerpts from ASME Codes, plus data on ASA flange ratings.

YOUR

New Catalogs GUIDE

287 TOOL STEELS

Crucible Steel Co. of America—A six-page index to Crucible tool steels and AISI type classifications. The cross index is an aid to making an accurate identification and selection of tool steels for specific jobs.

288 CYLINDERS

Ledeen Mfg. Co.—A 12-page bulletin illustrates and describes the company's line of cylinders for air, oil, water, gas or steam operation in medium, heavy and super-duty construction. Selection information, ratings and limitations, and rod and head attachments are included.

289 REVERSING DRIVE

Funk Mfg. Co.—A catalog illustrates and describes the firm's Reverse-O-Matic drive said to be adaptable to any equipment that has forward or backward, or up and down motion, such as road rollers or fork lift trucks. One-lever controls speed and change of direction. Standard flanges adapt it to other power transmission components, including power take-offs, right-angle drives, transmission and gear reduction.

290 ELECTRIC MOTOR CONTROLS

Furnas Electric Co.—Catalog 5900 gives information on application and selection of electric motor control. Included in engineering data, such as wiring diagrams, horse-power ratings, motor speeds, heater sizes, as well as other design information. Manual and magnetic starters, drum controllers, pressure switches, definite purpose control, and various pilot devices and accessories are covered.

291 POWER ROOF VENTILATORS

Ilg Electric Ventilating Co.—Eight-page condensed Catalog DB 7-102 describes and illustrates line of heavy duty propeller and centrifugal type power roof ventilators for all commercial and industrial applications. Detailed selection data is given for each model including range of sizes and capacities.

292 SUPERIOR BEARING METAL

Bearium Metals Corp.—Brochure, illustrated with photographs of a Torture Test, and describing nonseizing, nonscoring aspects of Bearium Metal. Metal available in rough-cast bars, pattern castings, centerless-ground rods, and machined parts.

293 CONTROLLED-AIR-DEVICES

Bellows-Valvair—Bulletins BM-25 and ML-5 illustrate and explain air motors and the choice of built-in valves and auxiliary hydraulic controls available for them. Bulletin ML-5 also describes the basic types of complete-work-units, such as power feeds, work feed tables, drilling units. Both booklets contain application photographs.

294 BRONZE BEARINGS

Bunting Brass & Bronze Co.—Catalog 258 lists 343 stock sizes of cast bronze electric motor bearings for all makes and sizes of electric motors. These are made exactly to dimensions of original equipment and fit without further finishing.

295 RIGID STEEL CONDUIT

Youngstown Sheet & Tube Co.—Bulletin summarizes four kinds of Buckeye steel electrical raceways for general applications and three kinds of Yoloy conduits for undergound raceways, industrial applications, and salt water exposure.

296 WATER DETECTION DEVICE

Ipsen Industries, Inc.—Bulletin WS-60 describes Water Sentinel, which detects water in concentration of 0.1 per cent or greater in enclosed type oil quench tanks or similar applications, triggering an alarm.

297 CONVEYER BELTING

Manhattan Rubber Div., Raybestos-Manhattan Inc.—A 12-page brochure, No. M302, covers new conveyer belting. Drawings are used to describe the compensation and other features. Pages are arranged to represent an actual cross-section of the belt. It is claimed no breaker fabric is required with this belt, which means more thickness of the cover is utilized.

298 CHEMICAL TREATMENT

Layne & Bowler, Inc.—Six-page folder illustrates and describes chemical treatment for water wells. It lists treatment materials and shows microphotos of bacteria found in wells.

299 GAS ENGINES

Nordberg Mfg. Co.—Power Chief 4-cycle gas engines for oil field service, available in 1, 2, and 3-cylinder units and a horsepower range of 8 to 54 for production pumping and water flooding, are described in a 12-page bulletin, No. 291A. Power Chief gas generator sets for rig lighting and microwave communications, available in all standard voltages ac and dc, are also described.

300 ASH SLUICING SYSTEM

United Conveyor Corp.—A four-page Bulletin No. 1S-57 describes recirculating closed circuit ash sluicing system with description of principle and sequence of operation.

301 STEAM SPECIALTIES

Strong Div., White Sewing Machine Corp.—Catalog 75 gives complete engineering data on Strong steam traps, strainers, separators, pressure regulators, and block steel valves. Common applications are discussed and selection tables are included.

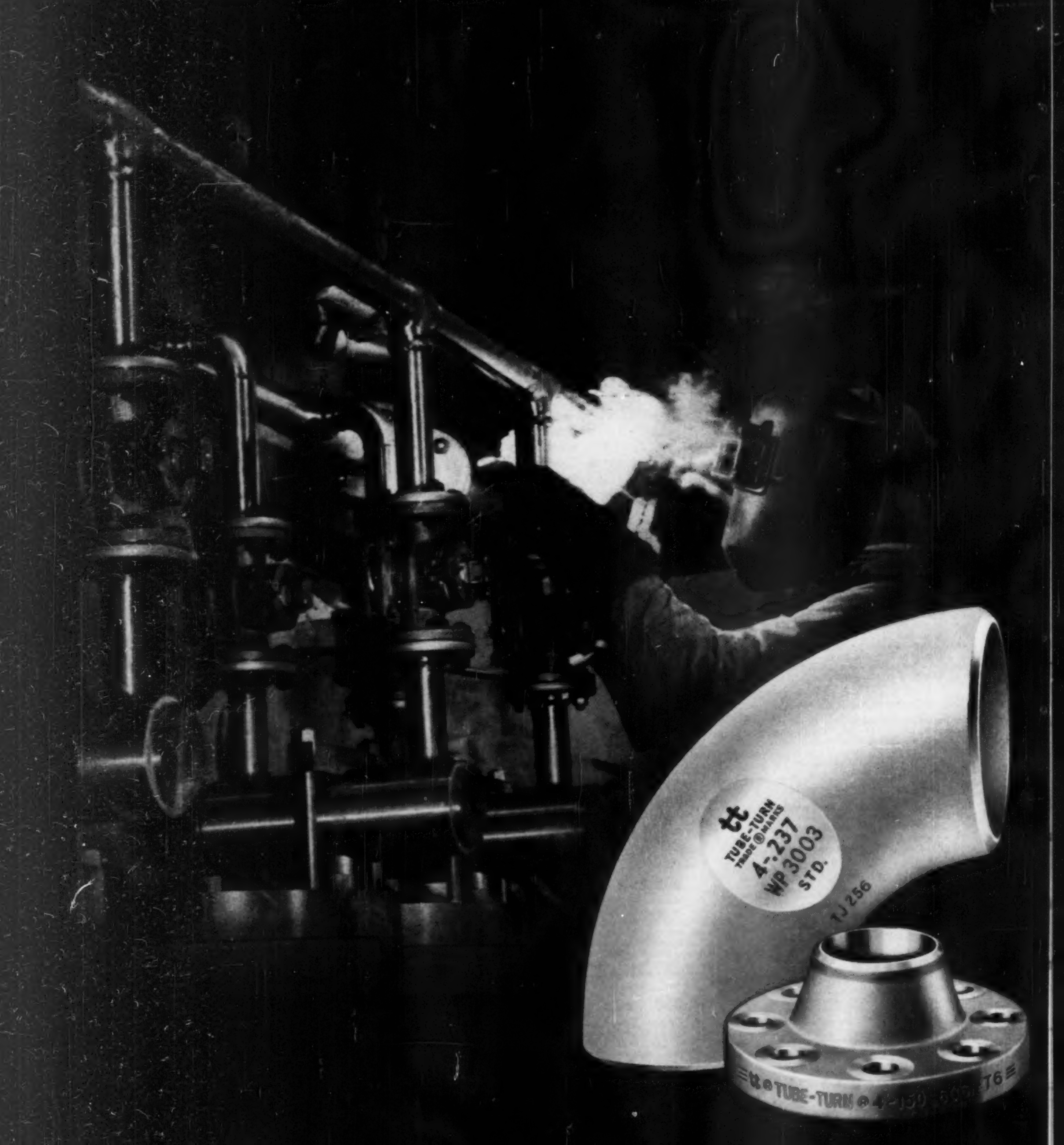
302 HEAT EXCHANGERS

Yuba Consolidated Industries, Inc.—A 16-page brochure, HB 461, covers shell and tube heat exchangers and Yuba's Transaire air-cooled units. The booklet contains illustrations and specifications of new structures, types of header designs, exclusive fintube construction, atmospheric sections, and Multilok closure.

303 SPREADER STOKERS

Hoffman Combustion Engineering Co.—Catalog No. 55-CAD describes and illustrates features of moving-grate spreader stokers. Catalog 55-PDG describes, illustrates, and supplies additional information on the spreader stokers with dumping grates. Capacities from 20,000 to 500,000 lb of steam per hour.

What's new in alloy piping components



YOUR *New Catalogs* GUIDE

308 VARIABLE SPEED DRIVES

Electric Machinery Mfg. Co.—A two-page leaflet describing a line of variable speed, magnetic drives from 5 to 300 hp. Leaflet shows construction by cut away views. The drives are used as a variable speed source for pumps, fans, and blowers. Said to be particularly adaptable for sewage pumping, the units mount between the drive motor and the pump.

309 QUICK-RELEASE PINS

Hartwell Corp.—A four-page, two-color brochure describes single- and double-acting quick-release pins. This literature is accompanied by 15 sheets of sales outline drawings, procurement information, and NAS numbers.

310 INDUSTRIAL EQUIPMENT

Nordberg Mfg. Co.—A 24-page Bulletin 293 describes the complete Nordberg line of machinery; radial and inline two-cycle, and V and inline four-cycle engines in diesel, gas, or Duafuel models; Power Chief diesel and gas engines and diesel engine generator sets; Symons primary gyratory crushers, cone crushers, vibrating screens and grizzlies; Gyradisc crushers, rotary kilns and dryers, and grinding mills; mine hoists; railway track maintenance machinery.

311 FASTENERS

Hartwell Corp.—A 75-page catalog is devoted to trigger action latches, self-closing latches, and flush hinges. This catalog carries 75 different latches, with complete procurement information incorporated, along with sales outline drawings of these particular latches.

312 POWER LUBRICATION

Lincoln Engrg. Co.—Eight-page brochure describes and illustrates the latest development in power operated lubrication systems, both automatically (full, and semi-) and manually timed. These systems are designed for application on existing facilities or original equipment.

313 BALL BEARING PILLOW BLOCKS

Link-Belt Co.—Four-page Folder 2951, describes the line of Series P2-300 self-aligning ball bearing pillow blocks in 31 shaft diameters. The series of heavy duty ball bearing blocks is equipped with self-aligning, single row, deep-groove precision ball bearings. They are available in a complete range of shaft sizes from 5/8 to 4 in., and are interchangeable with other makes.

314 ROTARY POSITIVE BLOWERS

M-D Blowers, Inc.—Six-page bulletin describes in detail 3 lobe rotary positive blowers. This design is said to permit higher speed and higher pressure operation with considerable savings in weight, horsepower, and cost. Catalog describes typical applications, gives performance data on all models, and lists special applications and accessories.

315 ASBESTOS-CEMENT BOARD

Philip Carey Mfg. Co.—Forum 6285 describes asbestos-cement board for exterior walls, partitions, linings, utility structures. The material is not affected by most acids, alkalis, fumes, heat, cold, weather, salt air. It is vermin and rodent proof, will not rot, rust or corrode, and needs no paint or protective coating. It can be painted for decorative purposes. Suitable for continuous temperatures up to 600 F.

316 MILLING MACHINES

Milling Machine Div., Cincinnati Milling Machine Co.—VerciPower milling machines are fixed bed, general-purpose types; horizontal and vertical styles, up to 50 hp spindle drive. Twelve-page catalog, M-2130, illustrates and describes the machine and its principal units and features and lists complete specifications and equipment.

317 CHAIN LUBRICATION MANUAL

Oil-Rite Corp.—An eight-page manual, Bulletin 1800, contains recommendations for lubrication of power drive chains as well as conveyor and elevator chains. Specific methods of chain oiling are presented, and ideas are outlined for lubrication of high temperature chains.

304 SOLENOID VALVES

Fluid Power Accessories, Inc.—Line of two-way and three-way solenoid valves for pressures to 3000 psi are featured in bulletin. Hardened and ground steel working parts are in aluminum housing. Two-way valves are available in 1/4, 3/8, and 3/4 in. NPT for a-c and d-c voltage. Three-way valves are available in 3/8 in. NPT size for a-c voltage maximum working pressure is 2000 psi.

305 TEFLON PRODUCTS

Sparta Mfg. Co.—Six-page brochure reports on the capabilities of custom molded Teflon Mechanical properties of TFE resins are given. Pictures show typical forms, shapes, and products. Research, planning, engineering, and production.

306 AIR DIRECTIONAL VALVES

Westinghouse Air Brake Co., Industrial Products Div.—An eight-page catalog describes, two-, three-, and four-way spool type directional valves with solenoid, lever, push button, pilot cylinder, cam, treadle, and pedal operators. Valves have tapped exhaust or open exhaust.

307 PUMPS

Fernholtz Mfg. Co.—Bulletins describe Helifern helical gear pumps and Helifern food pump. Technical data and cutaway drawings are included.

Requests limited to 25 catalogs. (Sorry, no catalog distribution can be made to Students.)

YOUR

New Catalogs

GUIDE

318 DEEP DRAWN SHELLS
Pressed Steel Tank Co.—A bulletin summarizes basic applications and economies possible using seamless cupped and deep drawn ferrous and nonferrous shells. Included in information on head shapes and types of open ends available, practical diameter to length ratios, wall thicknesses.

319 PNEUMATIC INSTRUMENTS
Republic Flow Meters Co.—Six specification folios cover null-balance-vector pneumatic instruments for utility and process control systems. Described are controller, pressure transmitter, differential pressure transmitter, temperature transmitter, and ratio relays.

320 SELF-ALIGNING BEARINGS
Southwest Products Co.—A 60-page catalog, No. 551, describes plain and rod end self-aligning "Monoball" bearings. Gives engineering drawings, tables of dimensions, and load ratings. Covers bore sizes to 6 in. Includes data on "Dyflon" self-lubricating types.

321 TEMPERATURE REGULATORS
Spence Engrg. Co.—An eight-page bulletin, 1014, details the application and proper selection of temperature regulators for instantaneous, storage, and process heaters and for cooling control. Complete line covers direct-operated, pilot-operated, and cascaded air-control temperature regulators. Application diagrams, steam and water flow tables, response curves, and design data are included.

322 ELECTROMAGNETIC CLUTCHES
Stearns Electric Corp.—Bulletin No. 226-J illustrates and describes line of electro-magnetic clutches, brakes, and combination clutchbrake units in large, small, and miniature sizes. Units with and without collector ring systems are shown. Torque ratings range from 25 in-oz to 180,000 lb-ft. Formulas are given to determine the size and type of clutch or brake for particular applications.

323 VALVES
Wm. Powell Co.—A large number of the more required kinds of bronze, iron, steel, and alloy valves are illustrated and briefly described in a 24-page condensed catalog. In addition to listing the materials in which the valves are available, all sizes, pressure and temperature ratings are given.

324 ROLLER BEARINGS
Torrington Co.—Catalog No. 361 describes heavy duty roller bearings having bore diameters from .6250 to 9.2500 in. The thin cross section bearings may either be run directly on hardened shafts or on inner races. The one-piece steel retainer accurately guides the bearing rollers and provides space for lubricant storage and circulation.

325 CONSULTING SERVICES
Nalco Chemical Co.—Bulletin D1 contains information on skills and facilities available to help develop, evaluate, and apply chemical products and processes in a wide range of technical fields. Among those discussed are water treatment, combustion, metallurgy, papermaking, and refining. Also contained is a complete discussion of contract research as carried out by Nalco laboratory and research personnel.

326 SOLIDS—CONTACT REACTORS
Cochrane Div.—Crane Co.—A 24-page bulletin on solids-contact reactors contains a cut-away photograph and several pages of plane and elevation drawings showing the variety of designs available. The bulletin discusses theory and problems of cold water clarification, advantages and applications of various designs. Auxiliary and supplemental apparatus is described.

327 PACKAGED BOILERS
Cleaver-Brooks Co.—Bulletin AD-137 which describes the specific advantages of packaged fire tube boilers and Springfield water tube boilers. It includes dimensions, ratings, and boiler room layout data.

328 PUMPS AND VALVES
Denison Engineering Division, American Brake Shoe Co.—Bulletin 204. Pumps and valves for the aircraft and missile fields are described in this bulletin. Fluid motors, pump motors, and pumps, both axial piston and vane type, are included. Check valves, surge damping valves, pressure control valves, and other types are covered.

329 HOT PROCESS SOFTENERS
Cochrane Div.—Crane Co.—Bulletin 4800 illustrates and describes hot process softeners for boiler plant water conditioning. Data is given on water treatment and the principles of operation of the firm's equipment are diagrammed.

330 DUST COLLECTORS
Torit Mfg. Co.—Six-page Folder No. 359 pictures and describes two types of Torit dust collectors, the cabinet cloth filter type and the centrifugal separator. Sixteen models are shown with their specifications, with typical installations. Torit's diamond dust collector, and exhauster, and several accessories are also pictured.

331 ABRASIVE SLURRY VALVE
United Conveyor Corp.—Bulletin No. 2V-60 describes newly developed valve for abrasive slurry applications. Valve can be installed in any position and has no slots or guides interfering with valve movement. Maintenance is said to be reduced to a minimum since there are no sliding metal to metal parts.

332 HONING EQUIPMENT
Micromatic Hone Corp.—An 8-page catalog, AR-143, explains Microhoning process, including stock removal and automatic size control. Applications, specifications, work capacities of machines for small, medium range diameters, long stroke vertical machines, horizontal machines, multiple-spindle machines are given.

333 LATCHES AND HANDLES
Hartwell Corp.—A 50-page, two-color catalog contains information on hook, pin, and rotary latches, plus handles. This catalog contains sales outline drawings of these various fasteners, along with procurement information.

YOUR New Catalogs GUIDE

334 PNEUMATIC CONVEYORS

National Conveyors Co.—Four-page Bulletin P58G describes pneumatic conveyer system for handling bulk materials such as polyethylenes and other types of plastic pellets, lime, alum, glass cullet, fine metal chips and borings, small parts.

335 DUST, FUME COLLECTORS

Northern Blower Co.—Bulletin 164 describes automatic bag type arresters, diagrams standard dimension factors and supplies table of dimensions and capacities. Separate additional bulletins contain similar data for standard bag type (not automatic), hydraulic type, centrifugal type, and portable dust collectors.

336 THREADED INSERTS

Rosan, Inc.—Literature describes steel insert trademarked Inserto. External thread provides anti-rotational lock. Units, designed with an internal hex, available with internal threads No. 4 through $^3/_8$ in. Internal thread lock optional.

337 HYDRAULIC FLUID

Shell Oil Corp.—A technical bulletin covers Irus fluid 902, a fire-resistant fluid of hydraulic applications. Information is given on safety and tests, operating advantages of the fluid, preparation and maintenance of hydraulic systems.

338 BELT CONVEYORS

Transall, Inc.—Four page brochure outlining the advantages of Transall prelubricated belt conveyor idlers. A check point list is included.

339 INTERNALLY THREADED TUBULAR RIVET

Tubular Rivet and Stud Co.—Eight-page catalog describes Perma-Nuts and contains design data and applications, showing solutions to attachment and fastening problems. Sectional drawings explain ways in which this one-piece rivet and nut simplifies design and assembly. Costs are said to be reduced because Perma-Nuts can be automatically fed and set in high-speed TRS machines.

340 THRUST MEASUREMENT UNIT

Waukesha Bearings Corp.—Catalog W-7 describes system of thrust measurement applicable to tilting pad type thrust bearings. Strain gage load cells used as integral part of thrust bearing permit continuous record of thrust load. The catalog describes applications, installation, and instrumentation for this system.

341 FLEXIBLE COUPLINGS

Dodge Mfg. Corp.—A 24-page bulletin, 901B, covers an expanded line of Dodge Para-flex flexible cushion couplings that absorb vibration and compensate for all combinations of shaft misalignment and end float. Included are a new PX280 coupling with more than twice the torque capacity of the next smaller size and a new PX90 intermediate size. Product photographs, engineering drawings and actual installation pictures are included with descriptions of standard, high speed, and fly-wheel types of Para-flex. Other data includes horsepower ratings, dimensions, prices, and weight.

342 O-SEAL GATE VALVES

Stockham Valves & Fittings—Catalog brochure describes in detail a line of soft seal gate valves. New design with O-rings in seat rings. Double block and bleed with double seating. Variety of materials and trims. Sizes 2 in. to 24 in.

343 DUST COLLECTORS

Western Precipitation Div. of Joy Mfg. Co.—Catalog G-100 covers seven types of equipment for dust and fume collection problems by electrical, mechanical, filter, and scrubber methods. The booklet also covers processing equipment. It is illustrated in color and contains diagrams of construction details.

344 PROCESS EQUIPMENT

Atomic & Process Equipment Div., A. O. Smith Corp.—A 16-page brochure, V-60, covers five research groups: welding, ceramics, metallurgical, electrical, and technical computing, and the part they play in the company's vessel manufacturing. The booklet emphasizes the Division's activities in the nuclear, petroleum, chemical, power, paper, aircraft, missile, and waste disposal fields. Welding, multi-layer construction, and glass fused to steel techniques are highlighted.

345 BLAST CLEANING

Pangborn Corp.—Bulletin 705 describes heavy duty Rotoblast cleaning barrels, with capacities from 15 to 102 cu ft. Bulletin 706 describes standard duty Rotoblast barrels, and Bulletin 805 the versatile Rotoblast tables. All use the Rotoblast wheel, which throws up to 80,000 lb of abrasive per hour. Bulletin 303A gives data and performance facts of Rotoblast steel shot and grit abrasives.

346 WELDING FITTINGS

Nibco, Inc.—Catalog H-2 describes "Husky" steel welding fittings for Schedule 40 piping. Specifications and acceptance guide are given for concentric and eccentric reducers, 45-deg and 90-deg elbows, straight tees, and reducing tees. Technical data, performance, materials, and properties are contained in the catalog.

347 BULK HANDLING CONTROLS

Electronics Control Div., Flo-Tronics, Inc.—Leaflet describes Flo-Tronics control instruments and equipment for bulk handling of dry materials. The many control points in a typical processing set-up are illustrated and some of the typical control instruments are tabulated.

348 LAMINATED PLASTICS

Formica Corp.—A condensed catalog of technical information describes services and product areas of the company's industrial products section. Included is information on Copperclad laminates, laminate sheet sizes, moldings, rods, tubes postforming, and special NEMA and special grade charts and a comparator chart.

349 APPLICATION ENGINEERED MOTORS

Franklin Electric Co.—An eight-page brochure illustrates the complete line of application engineered electric motors for cutting production cost and improving performance. Case history information is given.

350 INDUSTRIAL CONTROLS

General Controls Co.—Catalog lists a comprehensive line of the firm's products, including automatic temperature, pressure, level, and flow controls, as well as counters, switches, and automation controls. Also illustrated and described are industrial actuators, combustion instrument controls, controller indicators and pressure indicators. A section on the "Hydramotors" electro-hydraulic actuators having many patterns, designs, and valve body materials is also included.

351 FAN-COOLED PROCESS PUMPS

Byron Jackson Pumps, Inc.—An eight-page bulletin describes a line of pumps with maximum interchangeability. The bulletin shows how 72 basic combinations allow choice of features for any service with a standard pump, and explains fan-cooled bearing housing available to eliminate cooling water supply in many installations.

352 PORTABLE TEMPERATURE POTENTIOMETERS

Leeds & Northrup Co.—A four-page data sheet E-33 (5) gives detailed information on three low-cost portable potentiometers. A single and a double-range instrument are available in 15 temperature ranges while a third instrument is calibrated in millivolts. Complete specifications are provided and ranges for the temperature instruments are tabulated.

353 TROLLEY CONVEYORS

Link-Belt Co.—What a trolley conveyor can do to reduce manufacturing and handling costs, and how to select the right trolley conveyor for any requirement, are the two main topics of 58-page Book 2730. The book shows how trolley conveyors aid in many tasks, such as washing, finishing, drying, baking, cooling, assembly, testing, and storage. Included is complete information for design of a trolley conveyor system, with appropriate components, supports, superstructures, and guards. Complete tables of materials, dimensions, and specifications of components, easy-to-read drawings, and cutaway photographs showing construction features are given.

354 AIR CONDITIONING EQUIPMENT

Carrier Air Conditioning Co.—Catalog 36A87 introduces the new Carrier thru-the-wall unit for year-round air conditioning of new or existing multi-room buildings. Choice of four heating methods. Includes benefits, features, capacity ratings, tables, and diagrams as well as a special page on the exclusive heat pump type model.

355 ELECTRICAL CONTROL CABINETS

Industrial Equipment Co.—Brochure shows sizes and construction of metal cabinets for electrical and hydraulic control panels. Special types shown.

YOUR

New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

356 SURFACE GRINDERS & LAPPING MACHINES

Taft-Peirce Mfg. Co.—Catalog No. 318 explains features that have been added to the No. 1 precision surface grinder, the 6-in. rotary surface grinder, the 24-in. semi-automatic lapping machine, the 24-in rotary lapping machine, the Taft-Peirce back spot facing machine, and microstoning equipment. Also described are many accessories and attachments to extend the versatility of these machine tools.

357 ROTARY SLITTING LINES

Yoder Co.—A 75-page handbook provides information on slitters and allied equipment. Basic data on design, selection and operation of slitting lines, and specifications of slitters, uncoilers, recoilers, coil cars, and scrap choppers are included.

358 GENERAL CATALOG

Young Radiator Co.—Catalog 160 is a 32-page, 3-color publication which comprehensively covers young radiators, heat exchangers, supercharger air coolers, industrial and oil held equipment, and heating and air conditioning products. A presentation of scientific, nuclear heat transfer applications stressing technical research developments is included.

359 DATA PROCESSING

Consolidated Electrodynamics Corp.—Technical bulletins describe recording oscillographs, amplifying systems, and direct-writing oscillographs. Operating information and description of applications are also included. Bulletins 5119, 1623, 5124, 1500, 1638, and 5118.

360 VIBRATORY GYRATORS

Pangborn Corp.—Bulletin 1703 describes a line of vibratory finishing equipment. Bulletin 350 pictures barrel finishing media and Bulletin 351 lists cleaning, neutralizing, and non-abrasive deburring compounds.

361 FORMING ALUMINUM

Aluminum Co. of America—A 246-page hard cover book is a guide to aluminum's response to forming techniques, and a source of fabricating hints. The book is intended to indicate potential applications of formed aluminum and to help in selecting alloy, temper, and forming techniques. The book is illustrated and contains 22 tables.

362 COAL-FIRED PACKAGED BOILER

Foster-Wheeler Corp. — Coal-fired packaged steam generators are offered in three standard sizes: 43,000, 50,000, and 63,000 lb per hr, 250 psi. They are said to be easily converted to oil firing. Bulletin PG 59-4 details components, construction, and performance of the unit.

363 STEAM GENERATORS

Clayton Mfg. Co.—Catalog C-1018 covers steam generators which, when utilized in multiple installations, can meet requirements ranging from 500 to 72,000 lb steam per hr at from 15 to 300 psi. Complete engineering specifications are provided on each of the six models of steam generators, from 16.5 to 175 bhp.

364 RUBBER EXPANSION JOINTS

Crane Packing Co.—A four-page bulletin, P-338, gives construction features, ordering information, applications, and dimensions of John Crane rubber expansion joints available in three types: pressure, vacuum, and pressure and vacuum. They can be used at temperatures up to 180 F, and special types can be manufactured for operating temperatures up to 250 F.

365 DRAFTING EQUIPMENT

Eastman Kodak Co.—Kodagraph Materials Catalog provides illustrated, step-by-step examples of drafting and drawing reproduction short-cuts and savings with Kodagraph photo-reproduction films and papers. Features of these products are listed and described. Includes chart for selection of appropriate Kodagraph film or paper for various types of reproduction jobs.

366 TEST EQUIPMENT

American Instrument Co.—Catalog 561 describes and illustrates a line of constant-temperature and humidity equipment, including environmental chambers, enabling testing in accordance with JAN and MIL specifications, sub-zero cabinets, ovens (to 1000 C), incubators, sterilizers, and baths: general-purpose, heated, heated-refrigerated, refrigerated, and thermometer-calibrating. The 43-page catalog also includes a complete listing of all accessories and a handy temperature conversion chart.

367 DRIVES

Falk Corp.—Bulletin 7100.1 describes shaft mounted and flange mounted drives, Sizes 415 and 507. Design and construction advantages are included as well as selection and dimensional data, engineering drawings, and accessories. Cataloged for hp ratings up to 125, output torque up to 100,000 lb-in., and ratios of 15:1 and 25:1.

368 GATE VALVES

Lunkenheimer Co.—"King-clip" gate valves, designed to withstand corrosive actions too severe for lighter valves, are described in Circular 561. Reports are given on applications, features, and designs. The valve is made in two types—the iron-body, bronze-mounted for general corrosive service, and the all-iron for solutions which attack bronze but not iron. Steam pressure and water-oil-gas pressure ratings are listed, as well as specific dimensions for different "King-clip" designs. All designs are illustrated, including a cutaway for parts identification.

369 ASH-HANDLING EQUIPMENT

National Coal Association—A 22-page guide describes ash-handling equipment applications to commercial and industrial coal-fired plants and basic selection criteria. Systems covered are pneumatic, hydraulic, mechanical, and special integrations in package-type combustion equipment. Standard specifications and directory of selected equipment manufacturers are included. Contains 27 functional illustrations and four criteria tables.

370 VALVE PRESSURE-TEMPERATURE RATINGS

Ohio Injector Co.—Form 1014 provides a concise, ready-reference to pressure temperature ratings and minimum test pressures for bronze, iron, forged steel, cast steel, and ductile iron valves. Tables list adjusted pressure ratings for cast steel, forged steel, and ductile iron valves for specific temperatures ranging from −20 to 1000 F.

371 COAL FEEDING AND WEIGHING

Stock Equipment Co.—Bulletin 100A describes gravimetric and volumetric feeders, coal valves, scales, conical non-segregating distributors, alarm switches to feed and weigh any coal satisfactorily to pulverizers, cyclones, and stokers.

372 STAINLESS STEEL BALL BEARING

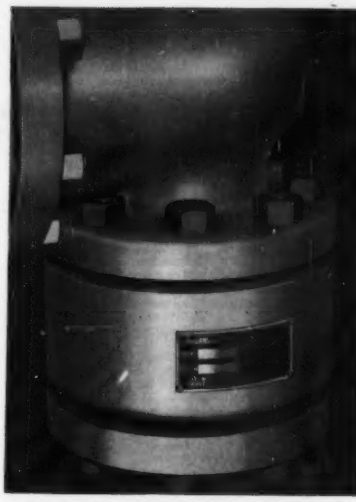
Marlin-Rockwell Corp.—A four-page bulletin, Form 1551, "MRC Stainless Steel Ball Bearings," includes the MRC line of stainless steel ball bearings available in the single-row, deep groove radial type used for most applications requiring this type steel. Complete dimensional details and load ratings data are shown. Typical applications are also listed.

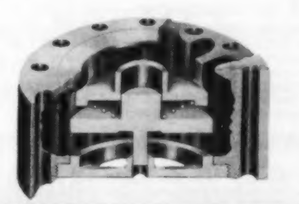
373 DIRECT CONTACT HEATER

Hynes Electric Heating Co.—Bulletin 3021 illustrates and describes a new electric heater design for the direct contact heating of gases to 1800 F at high pressures. Large kw ratings can be obtained in compact size with low pressure drop. —Nomograph simplified calculation of kw requirements for specific conditions.

374 HYDRAULIC CLUTCHES

Rockford Clutch Div., Borg-Warner—Bulletin 1405 describes and illustrates the application and operation of heavy-duty power shifting clutches. Specification data includes a line drawing, dimension tables, and representative performance for five sizes. These clutches are designed to be incorporated into transmissions where smooth, full power, high speed shifting is required.





375 SPEED REDUCERS

Falk Corp.—Bulletin 2100, 20 pages, illustrates and describes Falk's series of helical and bevel gear right angle horizontal speed reducers—Type YB. Cataloged are 22 new sizes with ratios of 5.06 through 1207 to 1, and torque ratings from 9000 to 1,570,000 lb-in. Design and construction advantages are included as well as selection and dimensional data. Explained are the easy methods of mounting motor brackets, backstops, brakes, and other modifications.

376 THERMOCOUPLE SYSTEM CALIBRATOR

Pace Engrg. Co.—A data sheet describes equipment for calibrating thermocouple recording systems. The calibrator is one in which the reference temperature and scale are established by injection of monitored voltages.

377 MOTOR SELECTION

Brook Motor Corp.—A 16-page bulletin, No. 929, entitled "Which Motor Should You Buy?," discusses a-c motor characteristics to help engineers in determining their needs. This bulletin serves as a "refresher" on integral horsepower motors—construction and application.

378 AIR FILTERS

American Air Filter Co.—Bulletin 510-C describes a line of filters, electronic, automatic, and unit, and discusses engineering and technical data such as construction, operation, and installation features, performance data, dimension and capacity charts, arrestance-resistance curves, application information, mechanical and engineering statistics, installation instructions, and servicing supplies.

379 PACKAGED BOILERS

Superior Combustion Industries, Inc.—An illustrated brochure describes completely packaged boilers, including fire-tube types in sizes from 20 to 600 bhp for pressures to 250 psi. Special models for hot-water operation, and water-tube types in sizes from 4000 to 72,000 lb steam per hour.

380 HEATERS

Electrofilm, Inc.—Brochure HB-3-359 gives applications and technical data for custom "sprayed-on" heating elements for use where a stable temperature environment is mandatory for the reliable operation of electronic components. The conductive and insulating coatings combined of sprayed-on type heaters are only .015 in. thick This allows the heat flow to spread rapidly and evenly over all areas of the oven resulting in an extremely small temperature difference between the actual element and the parts to be heated These heating elements may be applied to flat, cubicle or contoured surfaces of any kind or size.

381 BALL VALVES

Hills-McCanna Co.—A 2-page catalog describes entire line of top-entry and bar stock ball valves. It includes temperature and pressure charts, dimensions, weights; Cv ratings, vacuum service, data, corrosive service recommendations, air operators, PVC valves, special service valves, and other informative engineering data.

382 METALLIC HOSE

Universal Metal Hose Co.—A 70-page descriptive catalog of flexible metallic hose for high temperature conduction of liquids, steam, gas, grain or abrasive materials lists accordion pleated and interlocked spiral types with couplings and option of protective metal braid or plastic covering. Numerous applications are illustrated.

383 HIGH-TEMPERATURE-WATER GENERATORS

Babcock & Wilcox Co.—A 36-page Bulletin G-92 describes and illustrates high-temperature water systems for process and space heating in large plants, institutions, commercial and residential buildings. The bulletin also covers forced circulation generators and standard steam package boilers for high temperature water systems, and new technical data on high-temperature water.

384 STRUCTURAL SHAPES

United States Steel Corp.—Form ADUCO 01121 describes new quenched and tempered alloy steel structural shapes in USS "T-1" and "T-1" type A, 9% Nickel and HY-80. Shapes available (wide flange and I-beams, channels and angles), sizes, and weights are included. Mechanical properties and chemistry are given for the four steels.

385 DUST FILTERS

W. W. Sly Mfg. Co.—A 36-page Bulletin 104 describes dust filters and gives engineering information on dust control systems. Operating principles of the firm's Dynaclone are described, and dust filter system specifications and hopper and support data are included.

YOUR *New Catalogs* GUIDE

386 BOILERS, HEATERS, STOKERS

Bros, Inc.—Steam generating and other equipment for space heating, utilities, and process industries is included in a brochure which describes Bros package boilers, cross drum boilers, high temperature water generators, thermal liquid heaters, and stokers. The booklet includes cross-section drawings, capacities, pressures, temperatures, distinctive features, and recommended application for each type.

387 ALUMINUM EXTRUSION INGOT

Aluminum Co. of America—A 12-page booklet, "Alcoa Aluminum Extrusion Ingot," features comprehensive information on extrusion ingot alloys. Intended to assist extruders throughout the operation, from material selection to extruding pressures, to heat treating finished parts. The booklet details such extrusion alloy data as chemical composition limits, typical uses, mechanical properties, and recommended thermal treatment.

388 PUSH-PULL CONTROLS

Southwest Products Co.—An eight-page catalog, No. 1551, presents dimensioned drawings and specifications of compression and tension types of mechanical push-pull controls. Describes types with ultimate loads from 1250 to 3050 lb.

389 STEEL PLATE & SHEET

Youngstown Sheet & Tube Co.—Bulletin lists mechanical properties and applications of "Yoloy E" plates and sheets, said to offer long corrosion resistance, high strength, and weight reduction.

390 HEAT EXCHANGERS & BOILERS

Besler Corp.—Data available on heat transfer equipment for special requirements from light airborne units to large fixed facilities. Gas to liquid, liquid to liquid, gas to gas. Also high temperature, high pressure steam generators and superheaters.

Make use of this FREE LITERATURE SERVICE

A world of facts at your finger tips. Use coupon on page 140 for free catalogs you need.

391 MOTOR COUPLINGS

Link-Belt Co.—Six-page Folder 2975, brings together all the pertinent data on the company's motor couplings, including a new corrosive duty cover that has exceptional resistance to acids, alkalines and solvents for applications that subject couplings to chemical attack; a new spacer adapter that speeds and eases maintenance of coupling, driven pumps and compressors by permitting installation witk an access gap between shaft ends; and a larger size added to the line that now extends the application range of the couplings to a $2\,^3/_4$ in. bore size.

392 VALVES

A. W. Cash Co.—Correspondence from plant maintenance personnel brought about the need for a bulletin describing operation of various types of valves and stated in very simple terms. Bulletin 2200 is designed to give assistance to maintenance and create a better understanding between customer and manufacturer.

393 STAINLESS STEEL CLAD ON COPPER

Metals & Controls Div., Texas Instruments, Inc.—A bulletin gives technical data on stainless steel clad copper for application in the heat exchange field, where corrosive conditions dictate use of stainless steel for heat transfer surface. This metallurgically bonded surface can, depending on cladding ratios, increase normal conductivity by a factor of four over straight stainless steel.

394 POWER TRANSMISSION PRODUCTS

Boston Gear Works—A 664-page catalog, No. 57, contains complete specifications, illustrations, and selection information on a line of power transmission products, including gears, chain and sprockets, speed reducers, and bearings. Also includes 58 pages of engineering tables, formulas, and descriptive tests.

395 AIR POLLUTION CONTROL

Research-Cottrell, Inc.—Latest techniques and equipment for high-efficiency air pollution control are presented in a 12-page brochure. New air-cleaning precipitators designed for nuclear subs, automated controls, and high-performance silicon rectifiers are shown. Recent installations of gas cleaning equipment in basic oxygen steel plants, paper mills, electric utilities, cement and chemical plants are described.

396 RECIPROCATING COLD GENERATOR

Trane Co.—Catalog DS-352 describes and illustrates the Trane reciprocating cold generator, a complete factory-assembled refrigeration machine for chilled water systems, either comfort or process applications. Complete line contains 12 sizes with capacity range from 10 to 150 tons.

397 AFTERCOOLERS

R. P. Adams Co.—An eight-page bulletin, 715, covers a line of aftercoolers, heat exchangers, cyclone separators, and compressed air and gas filters. The bulletin lists applications and contains cutaway drawings.

398 LIQUID LEVEL GAGES

Gits Bros. Mfg. Co.—A 16-page Gits View Gauge Catalog contains technical data and illustrations of 168 styles and sizes of direct reading liquid level gages. Many new designs are included to give a wide choice of stock window gages, column gages, filler-type gages, sight flow gages, and visual feed oilers.

399 INDUSTRIAL INSULATIONS

M. H. Detrick Co.—A four-page brochure describes a line of block insulations, insulating cements, fireproofing cement, and weather-coating. Included is a reference table listing the products, their characteristics, use limit, and material requirements.

400 COMPRESSED AIR FILTERS

King Engineering Corp.—Catalog 6000 covers compressed air filters of 20 to 200 scfm capacity that remove all harmful traces of dirt, water, and oil down to 2 microns or less and normally go months without maintenance. The catalog describes new, exclusive scrub-and-polish action with cleaning-by-coalescence and lists models for all requirements, $^1/_4$-in. to 2-in. pipe size.

401 TECHNICAL BOOK CATALOG

John Wiley & Sons, Inc.—The 272-page 1962 Wiley catalog will be available in January. Wiley's active list of almost 2000 titles include books on aeronautics and space technology, architecture, chemical engineering, civil engineering, drawing and graphics, electrical engineering, industrial engineering and management, materials, mathematics, mechanical engineering, mechanics, metallurgy, and engineering.

YOUR

New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

402 HEAT EXCHANGERS
Yuba Heat Transfer Corp.—Bulletin HE461, describes transaire air cooled heat exchangers, Yuba shell and tube heat exchangers and atmospheric sections. The brochure gives detailed information on structures, fintubes, headers and other components furnished as part of complete air cooled units. Also detailed are various types of exchangers offered using TEMA designations.

403 VALVES
Circle Seal Products Co.—A technical 30-page brochure describes full line of check, relief, shut-off, plug, selector, manifold, and solenoid valves. Complete technical data, service recommendations, and ordering information on each valve are included, along with flow curves, operational principles, dimensions, materials, etc.

404 CONDENSER TUBE ALLOY
Phelps Dodge Copper Products Corp.—A brochure describes in detail the mechanical and physical properties of new tube alloy.—A Cufenloy 40 was developed for use primarily in high-pressure feedwater heaters where, because of its combination of high strength and corrosion resistance, it will substantially reduce unit costs. Other applications anticipated for this alloy include aircooler sections of main condensers.

405 DUCTILE IRON PUMPS
Food Machinery & Chemicals Corp., Peerless Pump Div.—Bulletin B 1314 describes series of single and multi-stage ductile iron pumps claiming excellent resistance to thermal shock and corrosion. Single stage Type A pumps available in sizes of 4 in. and larger has capacities to 60,000 gpm, heads to 400 ft. Type TU and TUT is multistage type, with heads up to 1500 ft, capacities of 3000 gpm.

406 DRAFTING SUPPLIES AND EQUIPMENT
Ozalid Div., General Aniline & Film Corp.—New Accessory Products Catalog describes, illustrates, and lists prices on tracing papers and films, drafting instruments and machines, drawing boards and accessory equipment for engineering drawing reproduction machines. Featured are new transparentized drafting vellums and dimensionally stable polyester films.

407 REFRIGERATED STORAGE FACILITIES
Chicago Bridge & Iron Co.—An eight-page brochure describes the design and function of facilities for the storage of liquefied gases between +32 F and −50 F. The brochure points up economy and safety as well as other inherent features of low temperature storage. Illustrations include vessels now in service and cutaway drawings of vessel types with descriptions of refrigerating systems.

408 PUMPS AND AIR COMPRESSORS
Worthington Corp.—A 24-page brochure detailing information on Standard industrial pumps and air compressors. Also included is hydraulic data and descriptive material on Worthington steam, rotary, power, centrifugal, regenerative turbine and circulating pumps. Also compressed air data and material on Worthington air compressors.

409 BOLTED FLANGES RING TYPE
Design and Research Associates—A 375-page manual containing over 30,000 ring-type flange designs covering 18 diameters: 6 to 60 in., 15 pressures: 50 to 1500 lb, 14 gasket factors: 2.0 and 1600 to 6.5 and 26,000, and 10 stresses: 10,800 to 17,500 psi. All designed in accordance with the ASME Code.

410 REFRACTORY METALS
Fansteel Metallurgical Corp.—Bulletin 051-102 describes advanced concepts in application of the refractory metals tungsten, molybdenum, columbium and tantalum. Bulletin gives details on chemical, nuclear, rocketry, and metalworking applications. Rolling, pressing, sintering, spinning, welding, forging, turning, milling, grinding, and bending are described.

411 ENGINEERING COMPUTER
Autonetics Div. North American Aviation.—Four-page RECOMP II brochure gives performance data and applications information on the "True Engineering Computer" and its peripheral equipment. The RECOMP II computer was designed around engineering and scientific problem solving requirements and offers a wide variety of special features for this field. This four-page brochure lists typical applications and relates special computer features to these.

412 TECHNICAL BOOKS AND PAPERS
The American Society of Mechanical Engineers—A 24-page catalog describing current books, standards, codes, research reports and periodicals published by the Society, also a listing of available technical papers.

413 BLOWERS
Roots-Connersville Blower Div. of Dresser Ind.—RAS-RGS Catalog covering their line of positive displacement blowers and gas pumps, Bulletin No. RAS 261.

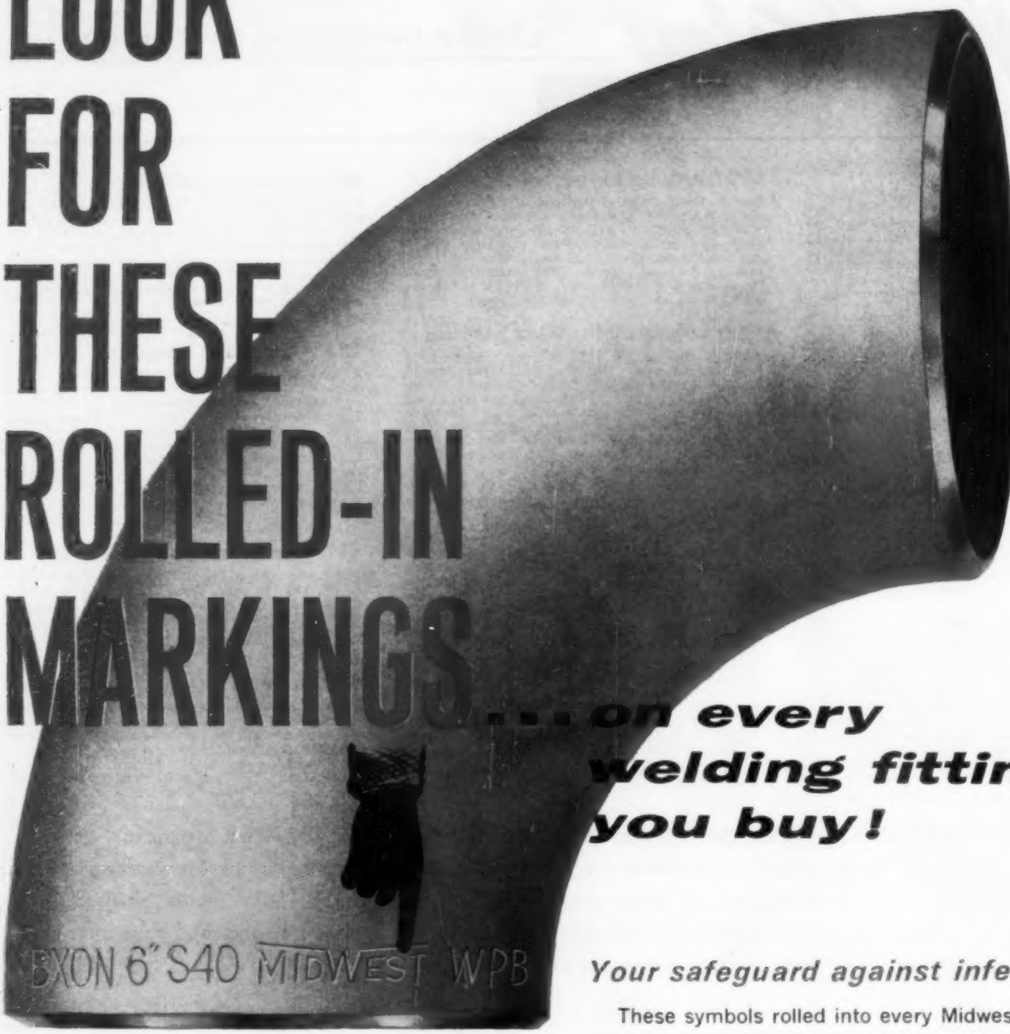
Your NEW CATALOGS GUIDE offers readers of MECHANICAL ENGINEERING an opportunity to secure advertisers' latest industrial literature available. In this issue there are 413 items to make selections from. For convenience, an index may be found on pages 139–141. Select desired catalogs by number, requests limited to 25 catalogs. Fill in coupon on page 140 and mail promptly. *(Must be mailed on or before date given on coupon.)*

Use This Free Literature Service--*Mail The COUPON Today*

MECHANICAL ENGINEERING

October, 1961 — CARD INDEX — Vol. 83, No. 10

LOOK FOR THESE ROLLED-IN MARKINGS ... on every welding fitting you buy!



Your safeguard against inferior quality

These symbols rolled into every Midwest fitting are your guarantee of brand-new fittings made from prime domestic steel in full compliance with ASTM and ASA standards!

Even the markings are made with specially designed low-stress dies to preclude injury to the steel. Care such as this demonstrates Midwest's sincere determination to manufacture fittings of highest quality throughout . . . unmatched anywhere!

Write for Bulletin 60C, ONLY MIDWEST MAKES BOTH, the story of how superior quality fittings are made from either seamless tubing or rolled plate.

BXON—**HEAT SYMBOL**— Used to identify physical properties, chemical analysis of raw material, radiographic control testing, and heat treatment.

6" S40—**SIZE AND WALL THICKNESS**

MIDWEST —**TRADE MARK**— Your Midwest distributor's guarantee of brand-new fittings made from prime domestic steel.

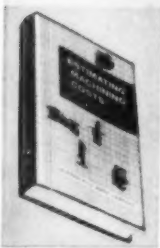
WPB **GRADE OF STEEL**—Your identification of the grade of steel . . . and your assurance that each Midwest fitting is made in full compliance with ASTM and ASA standards.

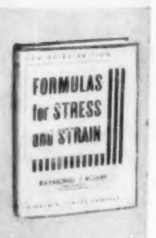
MIDWEST PIPING

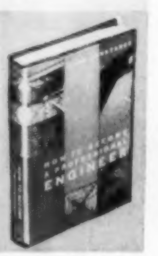
A Division of Crane Co. / 1450 South Second St., St. Louis 4, Mo.

6124

Circle No. 90 on Readers' Service Card







MECHANISM

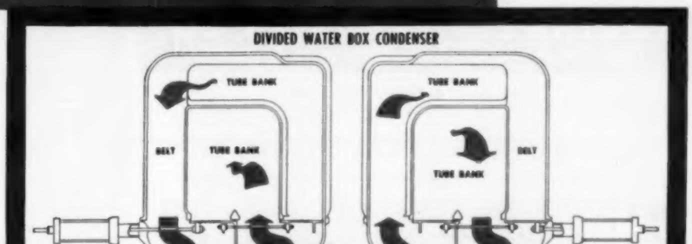
EPOXY RESINS

Successful Technical Writing

REVERSE FLOW "SELF-CLEANING"

ELIMINATES CONDENSER DOWN TIME

AND CUTS YOUR MAINTENANCE COSTS



C. H. Wheeler "Patented" Reverse Flow Condensers eliminate *manual labor* for cleaning. Refuse, twigs, leaves, debris, algae, or mussels are freed and washed away by back-flushing tubes and tube sheets, without shutting down the condenser.

Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure drop; hence high vacuum is maintained. Sluice gates for each half of the condenser move on a common stem. They are an integral part of the condenser and no extra external piping is required.

Each half of the condenser can be back-flushed independently or both halves can be flushed simultaneously, with either one or two circulating pumps operating.

For complete Reverse Flow "Self-Cleaning" story— write for catalog W-503. To know how Reverse Flow "Self-Cleaning" can cut YOUR condenser down time costs—call your C. H. Wheeler representative.

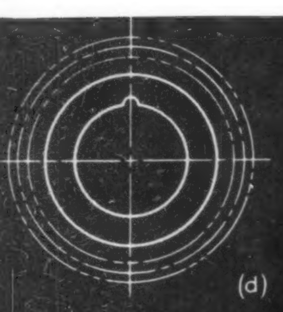
WGR

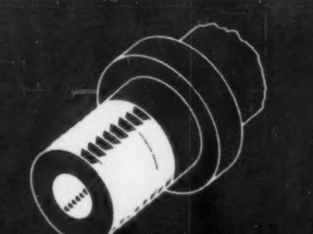
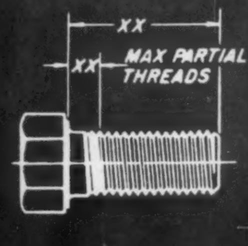
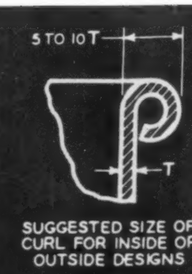
Affiliated sources for steam condensers, heat exchangers, pumps, nuclear steam generators and related components, sea water distillation plants, marine auxiliary equipment.

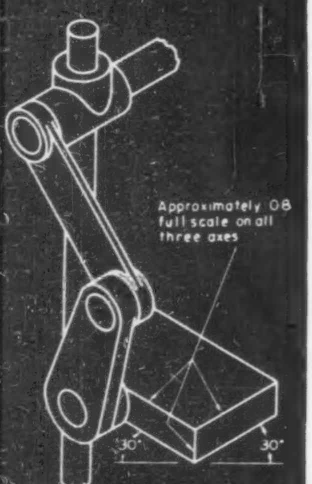
C. H. WHEELER / **GRISCOM-RUSSELL**

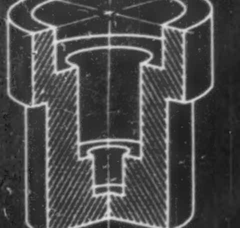
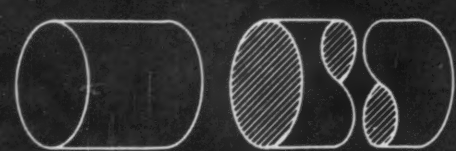
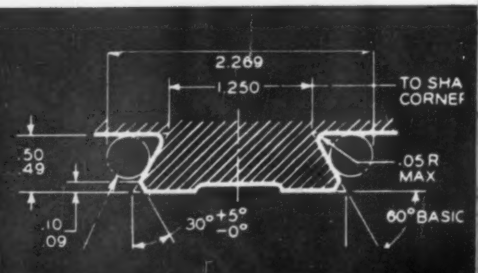
Philadelphia 32, Pa. — Massillon, Ohio

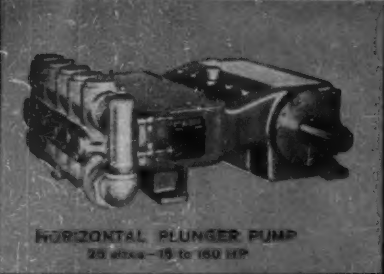
Circle No. 135 on Readers' Service Card

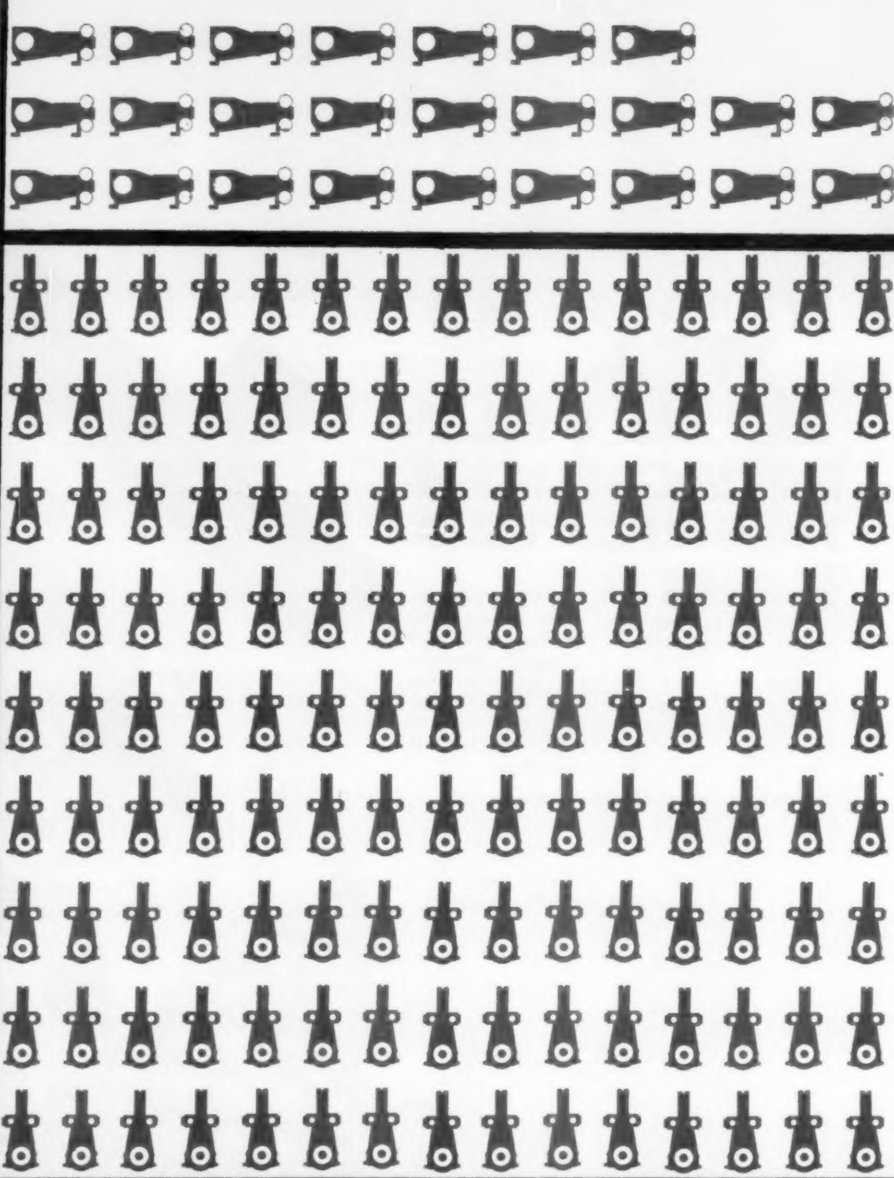

(d)



XX
XX
MAX PARTIAL THREADS

5 TO 10T
T
SUGGESTED SIZE OF CURL FOR INSIDE OR OUTSIDE DESIGNS

PREFERRED
NOT RECOMMENDED

Approximately 0.8 full scale on all three axes
30°
30°



Acceptable

2.269
1.250
TO SHA
CORNEF
.50
.49
.05R MAX
.10
.09
30°+5° −0°
60°BASIC


HORIZONTAL PLUNGER PUMP
25 sizes—15 to 160 HP




VERTICAL PLUNGER PUMP
135 sizes—20 to 900 HP

OPPORTUNITIES

positions open • positions wanted • equipment, material, patents, books, instruments, etc. wanted and for sale • representatives • sales agencies • business for sale • partnership • capital • manufacturing facilities

ANSWERS to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 345 East 47th St., New York 17, N. Y.

RATES: Classified advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $4.50 a line. $2.00 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display advertisements carried in single column units of multiples of one inch at flat rate of $45.00 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

POSITIONS OPEN

BECHTEL

San Francisco

Power and Industrial Division offers immediate employment opportunities for electrical, mechanical, or structural engineers capable of assuming responsibility on design of major steam or hydro power plants.

Relocation allowances cover moving costs plus transportation reimbursement for you and members of your family. If you have an interest in a San Francisco assignment, please send a resume of experience to W. A. Anderson, Technical Recruiting. Personal interviews will be arranged for qualified candidates.

Bechtel
Corporation
220 Montgomery Street
San Francisco, Calif.

In New York City, a personal interview can be arranged by phoning Edmund J. Orr, MUrray Hill 7-7100

DEVELOPMENT AND PROJECT ENGINEERS

Challenging position in progressive U.S. company, recognized leader in its field. To qualify for this position, you must have:

Enthusiasm to develop new products.
Imagination to visualize new approaches.
Ability to overcome problems.

Mechanical Engineering Degree (or equivalent) required. Minimum of eight to ten years' development experience in pipe valves, fittings and allied fields preferred, but main requirement is creative ability.

Please reply by letter giving full details of education, experience and goals. Responses will be treated in confidence.

Address CA-7222, care of "Mechanical Engineering"

Research Engineers Fluid Mechanics

Openings exist in a newly formed group investigating basic problems in the field of fluid mechanics. Areas of interest include flow stability and control, gas dynamics, nonsteady flows, turbulence and flow noise, turbomachinery flows, new concepts in fluid-handling devices.

These positions require highly qualified men with the capability of pursuing independent research. An advanced degree in engineering is required, and some research experience in fluid mechanics is preferred.

Laboratories are located in suburban New Jersey in the Summit-Springfield area.

Interested candidates please reply with full details of education, experience and salary requirements to:

DR. D. F. WHITE
American-Standard Research Division
Monroe and Progress Streets
Union, New Jersey

AMERICAN-Standard

MECHANICAL ENGINEERING

Research and Development Engineer to work with Director of Mechanical Engineering Division as specialist in applied mechanics. Includes stress, heat transfer, and thermodynamic analyses with practical experience or demonstrated interest in mechanisms. Requires ability to organize and present original ideas in R & D proposals. M.S. in Mechanical Engineering with strong academic record.

Send resume of your academic and career background, age, salary requirements, and professional references to:

Professional Personnel Recruitment ME

ATLANTIC RESEARCH CORPORATION
Alexandria, Virginia

WANTED

Electrical, Mechanical or Chemical Engineering Graduates to be trained as Sales Engineers for Cleveland, New York, Chicago, and Richmond, Virginia. We also have an opening for man with technical background for inside office work at Los Angeles. Prefer men between 25 and 32 years of age who have had industrial process experience. Successful applicants will be given a three-month factory course starting February 1, 1962. **Write Harry E. Beane, Vice President, The Bristol Company, Waterbury 20, Connecticut.**

DEVELOPMENT AND SALES ENGINEERS

VALVES and mechanisms for critical high-pressure, high-temperature services in the growing marine, petroleum, process and power fields—including nuclear power.

CONTACT R. A. Kampwirth, Edward Valves, Inc., subsidiary of Rockwell Manufacturing Company, 1200 W. 145 St., East Chicago, Indiana.

MECHANICAL ENGINEER

DEVELOPMENT

San Francisco Bay area. Outstanding opportunity with a promising future for an engineer capable of excercising ingenuity and creative thinking. Will assume full responsibility for complete projects in the design and development of special processes for the production and finishing of magnetic tape. Excellent salary, professional atmosphere, and company benefits in an ethical, highly respected organization. Send complete resume, including salary requirements to

F. S. Schlaepfer, Ampex Corporation
2409 Bay Road, Redwood City, California.

SALES ENGINEERS

Industrial sales experience, fluid mechanics background. Chemical feeders, proportioning pumps & metering equipment. These are responsible positions in assigned areas, various U.S. locations, involving technical sales and promotion with key accounts. Salary, expenses, company car. Submit resume indicating salary requirements.

Address CA-7228, care of "Mechanical Engineering."

POSITIONS WANTED

NEARLY BLIND

Graduate engineer experienced in plumbing, heating, air conditioning for commercial, industrial and school buildings can not see well enough to read or draw. BSME University of Arkansas 1956, Registered. Write specifications, do job inspection.

Address CA-7200, care of "Mechanical Engineering."

EMPLOYMENT AGENCIES AND SERVICE BUREAUS

ATOMIC PERSONNEL, INC.

WRITE FOR APPLICATION OR SEND RESUME
•
CONFIDENTIAL HANDLING

A NATIONAL EMPLOYMENT AGENCY for the NUCLEAR FIELD
•
NO CHARGE TO INDIVIDUALS

Suite 1207-P, 1518 Walnut St., Phila. 2, Pa.

SALARIED PERSONNEL, $6,000 to $35,000. This nation-wide service successful since 1927 finds openings in your field. Sells your abilities: arranges contacts. Present position protected. Write for details—Jira Thayer Jennings, P. O. Box 674, Manchester, Vermont.

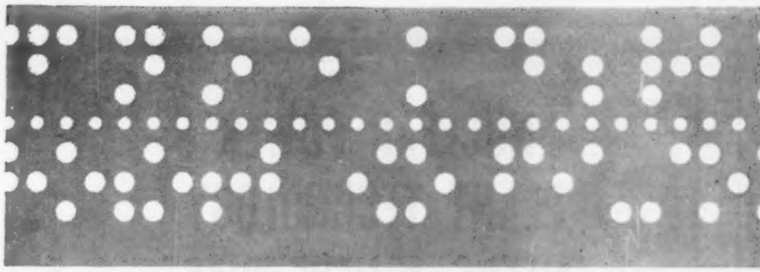
EQUIPMENT FOR SALE

SUBSONIC WIND TUNNEL, newly designed and constructed. 30 to 80 fps, 30" × 30" cross section, 20' long test section. Adjustable roof to permit varying pressure gradient, suitable for student instruction and research work. R. T. Shen, Colorado State University, Fort Collins.

MISCELLANEOUS

Reference: 8/25—Industriels...—DV/

Industrialists selling share in mechanical construction and old mining business—excellent reputation—regular dividends—excellent financial standing—central France—amount of share for sale, minimum 3 million New Francs. Write Havas 13.271 Avignon, France.



COMMUNICATION OF IDEAS

"Ideas must work through the brains and the arms of good and brave men, or they are no better than dreams."— *EMERSON*

Original painting by Emil Bisttram, Taos, New Mexico

Qualified applicants are invited to send resumes to: Director of Personnel, Division 61-96

los alamos scientific laboratory
OF THE UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO

All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin. U.S. citizenship required.

POSITIONS OPEN

SENIOR STRESS ENGINEERS for design engineering positions with heavy industrial company in Northeastern Ohio. Degree (MS preferred) in engineering, applied mechanics major, math minor (differential equations). Experience in pressure vessel design and thermal stress work. Ability to develop and establish analytical procedures to be used by other Company computing groups. Involves applications of theory of elasticity. Will work closely (and co-operatively) with other engineering sections in Company. Salary range to $10,000 commensurate with education and experience. Complete description of duties furnished to qualified applicants on request. Send resume. Address CA-7231, care of "Mechanical Engineering."

SALES-ENGINEER. Man with engineering background and sales experience to travel eastern United States by air, selling transportation service of electronic equipment, missile parts, and high-valued articles. Using patented shock-absorbing pallet and closed motor vans. Nationwide service. Responsible carrier. Prefer single man. Constant travel by air. Good salary, exceptional opportunity. Give complete resume, engineering education and sales experience, personal status and salary requested. Address CA-7204, care of "Mechanical Engineering."

MECHANICAL ENGINEER—Graduate—3 to 5 years experience and interest in hydraulic transportation of solids. Requires knowledge of fluid mechanics, pump, pipelines and ability to write engineering reports. Position with an independent research group with an academic connection. Job consists of experimental and theoretical work with variety of materials. Location Rocky Mountain area. Address CA-7241, care of "Mechanical Engineering."

ENGINEER—Position as Director of Engineering for well known publication with extensive laboratory facilities located in NYC. Opportunity for qualified engineer to supervise an investigatory program covering many areas of products as well as to develop editorial ideas. Degree in Mechanical or Electrical Engineering required as well as some experience. Ideal situation for man interested in a future. Must have administrative ability and capable directing a staff. Write fully, stating salary desired. Address CA-7243, care of "Mechanical Engineering."

MECHANICAL ENGINEER, 5 years experience in multi-staged high compression engines. Major chemical plant in southern location. Salary commensurate with qualifications. Age 25–35. Send resume to W. R. Hayes, Monsanto Chemical Company, Agricultural Chemicals Division, St. Louis 66, Mo.

Registered HAV ENGINEER with at least 5 years' experience needed for permanent employment by Middle West consulting engineers. Excellent potential with growing firm. Please send resume, salary requirements and availability. Address CA-7212 care of "Mechanical Engineering."

FIELD ENGINEER. Permanent position for graduate mechanical engineer thoroughly experienced in all branches of industrial building construction. Moving expenses paid. Send complete resume. Address CA-7245, care of "Mechanical Engineering."

POSITIONS WANTED

PROJECT MANAGER, CONTRACTS ADMINISTRATOR, Age 42, over 20 years' experience in engineering and contracts administration. Strong mechanical background. Mining, steam generation, petro-chemical plants, papermills, airbases, missile launchers, heavy and general construction. Thoroughly competent in all phases of contracts administration and engineering office management. Previous foreign experience. Very good Spanish. Excellent references. Presently employed by engineering and consulting firm. Desire responsible position compatible with outlined experience record. Prefer Europe or Latin America but will consider other locations. Address CA-7220, care of "Mechanical Engineering."

PROJECT MECHANICAL ENGINEER, M.S. Degree, registered P.E. 18 years experience in machine design-development both as practicing engineer and as administrator, well grounded in fundamentals of theoretical and experimental mechanics, stress analysis techniques, vibration analysis, mechanical properties of materials, manufacturing processes, Author and inventor. Desires responsible position in organization engaged in substantial long-term mechanical development projects. Address CA-7240, care of "Mechanical Engineering."

MECHANICAL ENGINEER. P.E.—presently materials handling engineer in large manufacturing plant. Background in design, purchase, installation and repair of overhead cranes and lifting devices Considerable shop, field and electrical experience. Desires more scope and responsibility. Address CA-7237, care of "Mechanical Engineering."

MECHANICAL ENGINEER. 23 Years design and construction, pipelines, instrumentation, fluid flow, gas compression, EDPM, surveying. Registered Professional Engineer. Desires teaching, consulting, sales or small industrial position in Utah or San Francisco Bay Area. Address CA-7238, care of "Mechanical Engineering."

Graduate MECHANICAL ENGINEER, 12 years sales-engineering experience, managing, selling, designing, estimating, executing industrial insulation contracts, both hot and cold. Interested in new or related field. Address CA-7242, care of "Mechanical Engineering."

CONSULTING SERVICE

Manufacturers of equipment not included

RATES: One-inch card announcements inserted at rate of $30 each issue, $25 per issue on yearly contract

...for almost <u>any</u> fluid in the world!

You have no corrosion problem with Homestead's new Ball Valves, because they are offered in the right combinations of seals and metals for almost any fluid in the world. No leakage problem, either, because Homestead's self-adjusting ball and flexible seal stop flow in either direction. Adjustable packing gland prevents leakage to the outside of valve, too. You'll like Homestead Ball Valves' quarter-turn operation; choice of full round pipe-sized passage or restricted area in either bar-stock or slip-out design, and flow direction indicator that stays on when handle is removed. What's more, you'll find that all of these features add up to lower cost-per-year valve service. For full details, write for free catalog, Reference Book 39-5.

hv

HOMESTEAD VALVE MANUFACTURING COMPANY
"Serving since 1892"
P.O. Box 38 — Coraopolis, Pennsylvania

Makers of Homestead Ball Valves, Cam-Seald, Lever-Seald, and Lubricated Plug Valves

Circle No. 69 on Readers' Service Card

INDEX TO ADVERTISERS

Advertisers appearing in previous 1961 issues

***** **The asterisk indicates that firm has product catalog in the 1962 Mechanical Engineers' Catalog.**

Your attention is directed to

*Babcock & Wilcox Co.
  Tubular Products Div., Fittings Dept.
Bahnson Co.
Barco Mfg. Co.
Bell Telephone Labs.
Bendix Computer Div.
Bonney Forge & Tool Works
*Brown Fintube Co.
Bundy Tubing Co.

Carborundum Co.
Chace, W. M., Co.
Chapman Valve Manufacturing Co
Cleveland Worm & Gear Div.
  Eaton Mfg. Co.

Day Co.
DeZurik Corp.
*Diamond Power Specialty Corp.
Dow Corning Corp.
Dwyer, F. W., Mfg. Co.

Electrofilm, Inc.
Electronic Associates, Inc.
Ellison Draft Gage Co.

Fairbanks, Morse & Co.
*Falk Corp.
*Flexonics
  Div. Calumet & Hecla
Flo-Tronics Inc.
Foxboro Co.

General Motors Research Labs.
Genie-Air Products
  Div. N.T.W. Corp.
General Radio Co.
German American Chamber of Commerce
Gray Tool Co.
Great Lakes Steel Corp.
  Div. National Steel Corp.
Grinnell Co.

*Hoffman Industries, Inc.
  Air Appliance Div.

Imperial Tracing Cloth

*James, D. O., Gear Mfg. Co.
Jeffrey Mfg. Co.
Johnson, Carlyle, Machine Co
Jordan Co.
  Div. OPW Corp.

Kano Laboratories
Kato Engineering Co.
*Keeler, E., Co.
*Koppers Co.
  Coupling Dept.
  Piston & Sealing Rings

Lefax Publishers
Lukens Steel Co
Lunkenheimer Co

*Marsh Instrument Co.
  Div. Colorado Oil & Gas Corp.
Monsanto Chemical Co.

Nagle Pumps, Inc.
Nalco Chemical Co.
Nice Ball Bearing Co.
Nordberg Manufacturing Co.
*Norwalk Co.

PIC Design Corp.
  Sub. Benrus Watch Co.
Pace Engineering Co.
*Pangborn Corp.
Philadelphia Gear Corp.
Philbrick, George A., Researches, Inc.
Pipe Fabrication Institute
Posey Iron Works
Pulsation Controls Corp.

Raybestos-Manhattan, Inc.
  Manhattan Rubber Div.
Recordak Corp.
  Sub. Eastman Kodak Co.
Roots-Connersville Blower Div.
  Dresser Industries, Inc.
Royal McBee Corp.
Rust-Oleum Corp.

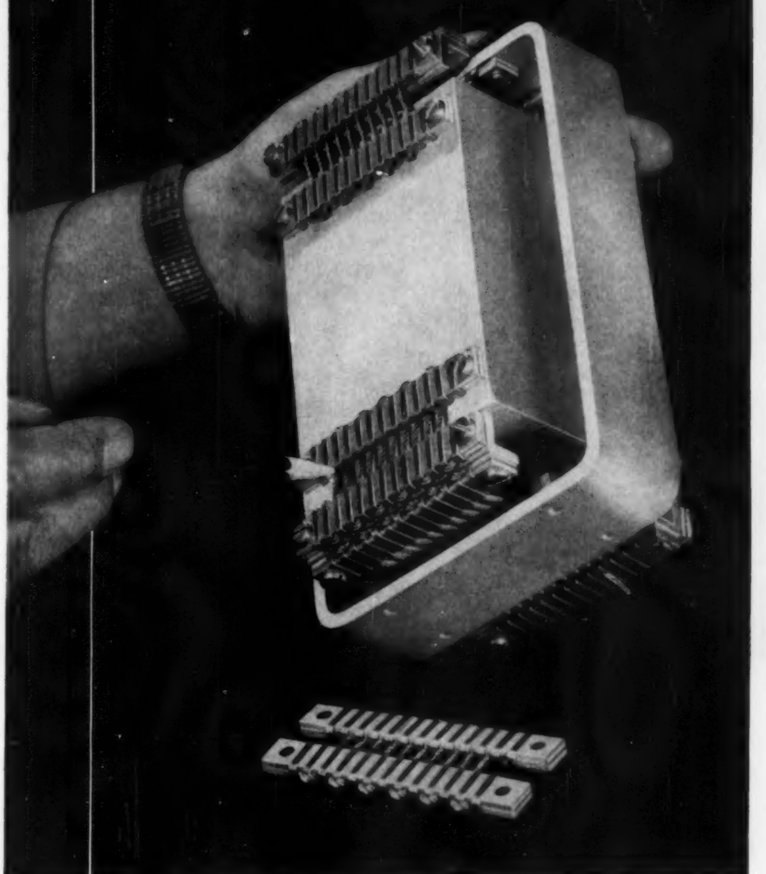
*SKF Industries, Inc.
*Sandusky Foundry & Machine Co.
Spraying Systems Co.
Stanford University Press
Stewart, F. W., Corp.
Stock Equipment Co.
Streeter-Amet Co.
Struthers Wells Corp.
  Div. Titusville Iron Works

*Terry Steam Turbine Co.
Titusville Iron Works Co.
  Div. Struthers Wells Corp.
*Twin Disc Clutch Co.

*Union Iron Works
  Div. Riley Stoker Corp.
Uni-Flex Mfg. & Engrg. Inc.
United States Graphite Co.
  Div. Wickes Corp.
United States Pipe & Fdry Co.

W-K-M- Division of ACF Industries, Inc.
Waldes Kohinoor, Inc.
Western Electric Co.
Winsmith, Inc.
Wood, John, Co.

Yoder Co.
York Corp.
  Sub. Borg-Warner Corp.
*Yuba Consolidated Industries, Inc.

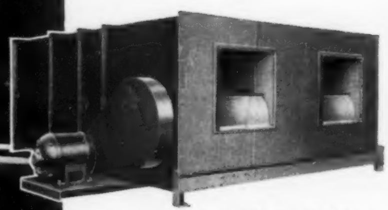


OWNER:
State of Texas

ARCHITECTS:
State Building Architects (Atlee B. and Robert M. Ayres, San Antonio; Cato & Austin, Houston; George L. Dahl, Dallas; Kuehne, Brooks & Barr, Austin; Stone & Pitts, Beaumont)

MECHANICAL ENGINEERS:
Zumwalt & Vinther, Dallas

MECHANICAL CONTRACTORS:
Way Engineering Company, Austin



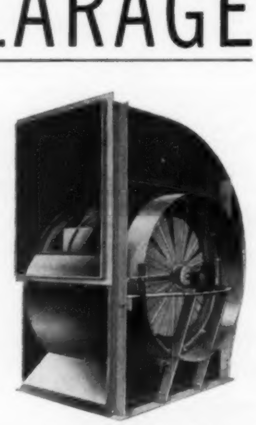
Typical Clarage Multitherm air conditioning unit.

a capitol investment: CLARAGE

New Texas State Office Building chooses Clarage air handling and conditioning equipment

When State Office facilities in Austin, Texas were expanded to include this new 10-story building, Clarage equipment became an integral part of the mechanical system. Serving the double duct, high velocity system are 5 Type NH Fans, 2 Unicoils, 2 Blow-Thru Multitherms, 7 Draw-Thru Multitherms, and 3 Unitherm Fan Units — all Clarage products.

Why is Clarage so often chosen for buildings of all types, all sizes? Largely because of this equipment's long-standing reputation for quiet, economical, dependable service. Call us in on your next requirements in air handling.



Typical Clarage Type NH system fan.

Dependable equipment for making air your servant

CLARAGE FAN COMPANY

Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

Circle No. 35 on Readers' Service Card